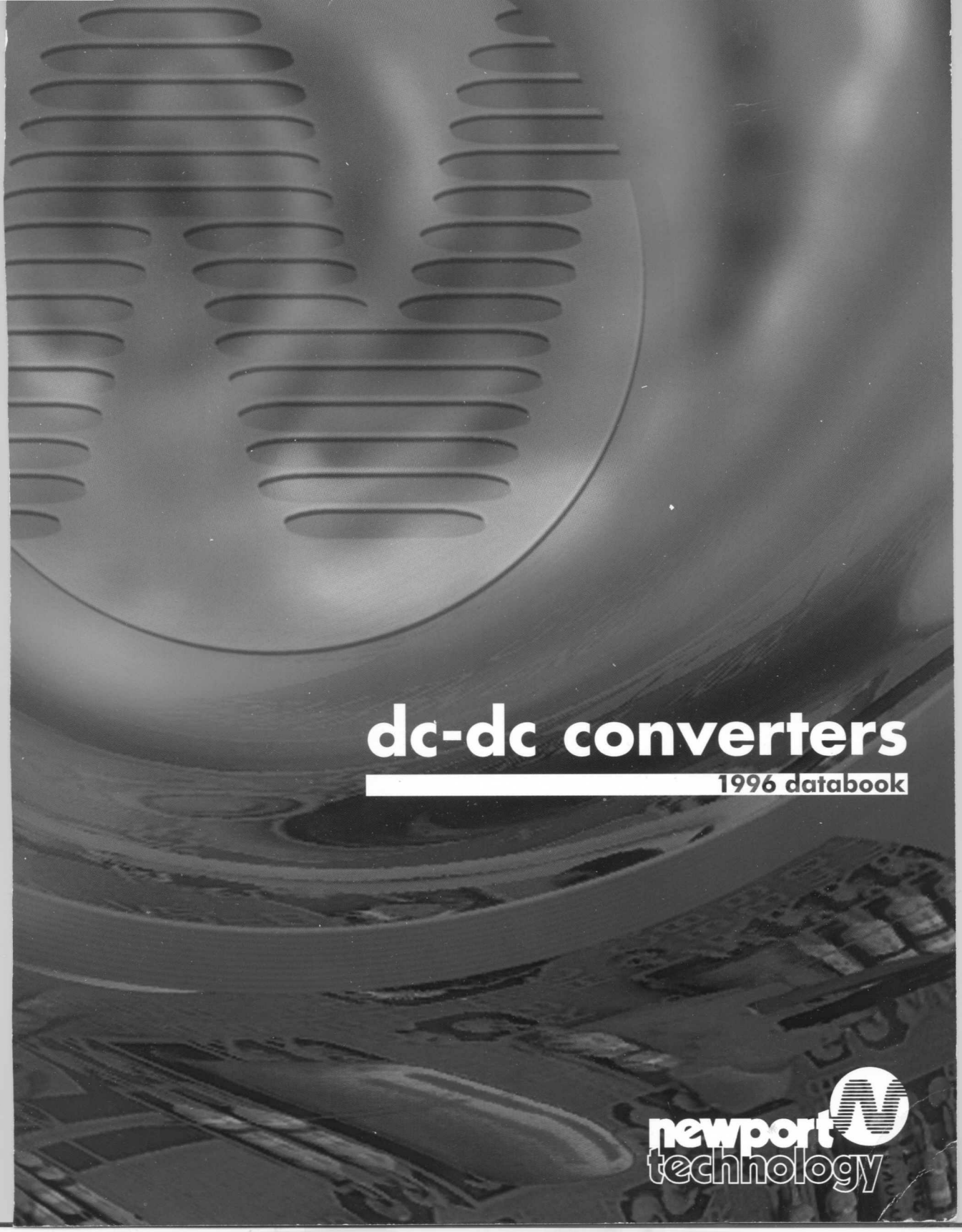

dc-dc converters

1996 databook

newport technology

dc-dc converters

1996 databook

newport technology

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LIFE SUPPORT APPLICATIONS POLICY

Newport Technology products are not authorized for use as critical components in life support devices or systems without the express written approval of the president of Newport Technology, Inc.

As used herein:

(I) Life support devices or systems are devices or systems which, (A) are intended for surgical implant into the body, or (B) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.

(II) A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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Founded in 1982, with a history stretching back over fifty years, Newport are proud of their position as the leading manufacturer of micro-ferrite based electronic components.

As the first company to offer a range of miniature DC-DC Converters in the sub-2 Watt power range, Newports success is built upon technical innovation. Ongoing investment in products and processes has enabled the company to continue to operate at the leading edge of technology.

Quality is fundamental to the Newport philosophy and plays a key role in all aspects of the business. Newports Quality Management System was awarded BS EN ISO 9001 in 1990. This standard is now regarded as a platform for developing a greater appreciation of the Quality needs of our customers. Success in this area is recognised by the award of approved supplier status by several major electronics companies.

Recognising the demands of today's designers, Newport continues to make progress in a number of areas including reduced footprints, higher isolation and improved packaging technology. This continual drive for progress has lead to a number of 'world firsts'. Within this engineer's reference you will find the smallest 2 Watt DC-DC converter currently available (the NML) and the TM series of Surface Mount DC-DC Converters. This new packaging process employs manufacturing processes more commonly associated with Integrated Circuits than hybrids, thus improving reliability and reducing production costs for our customers.

The high-quality product range is backed by high-technology manufacturing processes and techniques. A state-of-the-art automatic placement and reflow line is in place at the company's Milton Keynes headquarters. This purpose-built factory also houses a semi-automatic chip and wire bonding operation that allows levels of miniaturisation not available to other suppliers of DC-DC Converters. Manufacturing resilience and security of supply issues are addressed through a second manufacturing facility in the North of England and a (wholly owned) high-volume production plant in the Peoples Republic of China.

An ongoing commitment to customer service and satisfaction is the reason Newport has maintained their market-leading position. We recognise the need to provide a high level of service at all times to support our customers in achieving their business goals. In support of this objective, we serve all of the key global markets through a network of some forty distributors, agents and representatives world-wide; ensuring support and information is available locally to all of our customers. This extensive network is backed by Newports own technical support desk which is able to deal with detailed technical issues.

Within this book, you will find a comprehensive range of micro-ferrite Power-related components. This range is used in a multitude of

applications ranging from Industrial Controls, Instrumentation and Communications through to consumer-oriented electronics. Whilst we are confident this range will cover most of your needs, we are pleased to offer a custom design service for those situations where an application-specific product is required. This service applies to all products within the Newport range and offers a rapid design and sampling cycle followed by prototype quantities and full production. Please contact the Technical Support team or your local distributor to discuss your requirements in more detail.

Newport is committed to you as a customer and supporting you through the application of our technology in solving your design challenges and aiding you in achieving your business goals.

Newport has always operated a quality system within the company and this is encompassed throughout all parts of company activity and instilled in all members of our staff. Since 1990 this has been independently assessed and certified to ISO 9001 by the British Standards Institute Quality Assurance (BSI), which includes regular, bi-annual quality audits. This is an independent guarantee to our customers not only of the quality of design and manufacture of our components, but also of quality of our customer service and general operating procedures.

Regular audits by an independent assessor ensures that the quality principle is maintained and improved as the company progresses, ensuring that at all times quality is uppermost in the philosophy adopted as the company grows. Quality is not a static objective, continuous improvement in all aspects of company activity is written into the procedures governing our quality.

process quality

The production process lines in our factories are developed by ourselves to optimise the quality of every aspect of production, producing consistent, high quality processes and methods which not only improve end product quality but which also significantly reduce cycle times and cost of production. In some instances we have been a world leader in an area of development (e.g. surface mount DC-DC converters), which carries the onus of setting the quality standard by which the rest of the world must follow. Where international standards exist (e.g. CECC 00802 for reflow soldering) we ensure that our systems can perform to this as well as our products.

Our process development team are well respected and we have helped many of our customers improve their processes and hence their quality levels. Enclosed within this data book is further information or our recommended reflow profiles for our product range.

product quality

Product quality is designed in from the start of any new product development, enhanced by advances in our suppliers products and our own process developments to ensure that what we deliver are the highest quality parts available in their price-performance sector. All products undergo stringent quality assessment at the design and development stage, however, along with continuous process improvements, continuous product improvement is a significant factor in our quest to maintain our world leading position. Whenever our component suppliers improve a process or product or we improve our processes these are trialed and assessed prior to inclusion into our product lines. Many of these improvements are invisible to the customer as the performance improvements are implemented into existing products without adding cost to the customer and only sometimes spawn new product developments.

customer service quality

All our products are supported by comprehensive technical data and application information, however, this is not always sufficient for certain customers. Where more detailed information is required a technical helpline is available for all our

customers. This is supported by our process and product development teams to ensure that answers to virtually all technical customer enquiries can be handled.

Sometimes errors do occur and another aspect of customer service is our returns and failure analysis facilities. We have an easy to use returns system which guarantees fast response to any problem encountered by our customers, this includes an analysis of failure modes if a component is returned damaged and often help on how to avoid repeating this damage to our components in future.

customer quality audits

As an ISO 9001 certified company for design, manufacture and supply of our products most customers accept this as a guarantee of our quality system. Some customers still require independent quality audits by their own personnel and wherever possible we will attempt to accommodate these so we can demonstrate the claims we make on paper. This is extremely time consuming and not available to customers without prior notice, please contact our quality department if you require an audit.

Please note that our independent quality auditor (BSI) have the right to call in for an audit at any time, if this should happen when a customer audit was scheduled we would have to cancel the customer audit and re-schedule.

quality awareness

All our personnel are imbued with a quality awareness and the importance of continuous improvement. At Newport we use our quality system as an active part of our working process, hence, quality is considered at all stages of company activity by all personnel. Quality is not an 'inspected' or 'tested' philosophy but an ongoing part of our working routine, guaranteeing that what we deliver is of the highest standards, whether it is actual product or services, both to our customers and within the company itself.

Newport has a long history of design experience in both wound magnetics and hybrid components. This unique combination gives Newport the advantage over its competitors in the depth of understanding and design knowledge for users of inductive components, transformers and DC-DC converters alike.

All Newport products are designed to exceed their stated specification, this produces high reliability components that guarantee superior functional performance over their full operating range. The conservative specification enables us to achieve high production yields and hence helps to maintain a cost effective product.

DC-DC converters

All DC-DC converter products are manufactured using the highest quality surface mount components. These include high grade ceramic passive components, featuring high stability and excellent reliability, and high voltage active components, exceeding the normal operating maximum by several times the rated specification. All our DC-DC converters are designed for optimum thermal stability and high power efficiency, this includes the use of high thermally conductive encapsulant materials, ceramic substrates with plated copper tracking (more commonly found in high reliability automotive and aerospace applications), metal leadframe technologies and our own clean room enables us to assemble bare die where the ultimate packing density is required. Our experience in design of wound products enables optimised transformer design for the DC-DC converter, featuring toroidal transformers for minimal (near-zero) radiated emissions (EMI) with an accurate and stable operating frequency.

design flow

The enclosed flow chart (see figure 1) shows the typical design flow. The origin of new designs are either a technical or market requirement determined by Newport or a specific customer request. An example of a Newport generated design is the NML single output 2W miniature DC-DC converter, which was a perceived market from the response we received from customers to our NMH dual output 2W DC-DC converter.

Customer requests can take two forms; Custom or Standard Modified. Custom designs are exclusively for the one customer, the customer provides a full input/output or application specification and Newport designs and manufactures the part. Standard Modified is a part which is similar to an existing product an example of this is DC-DC converters with unusual input or output voltages.

All products go through the same rigorous design stages, starting with the initial feasibility, verification, validation and final design review prior to release to production. All these procedures are additional to the standard production quality procedures and are assessed within our company quality standard; ISO9001.

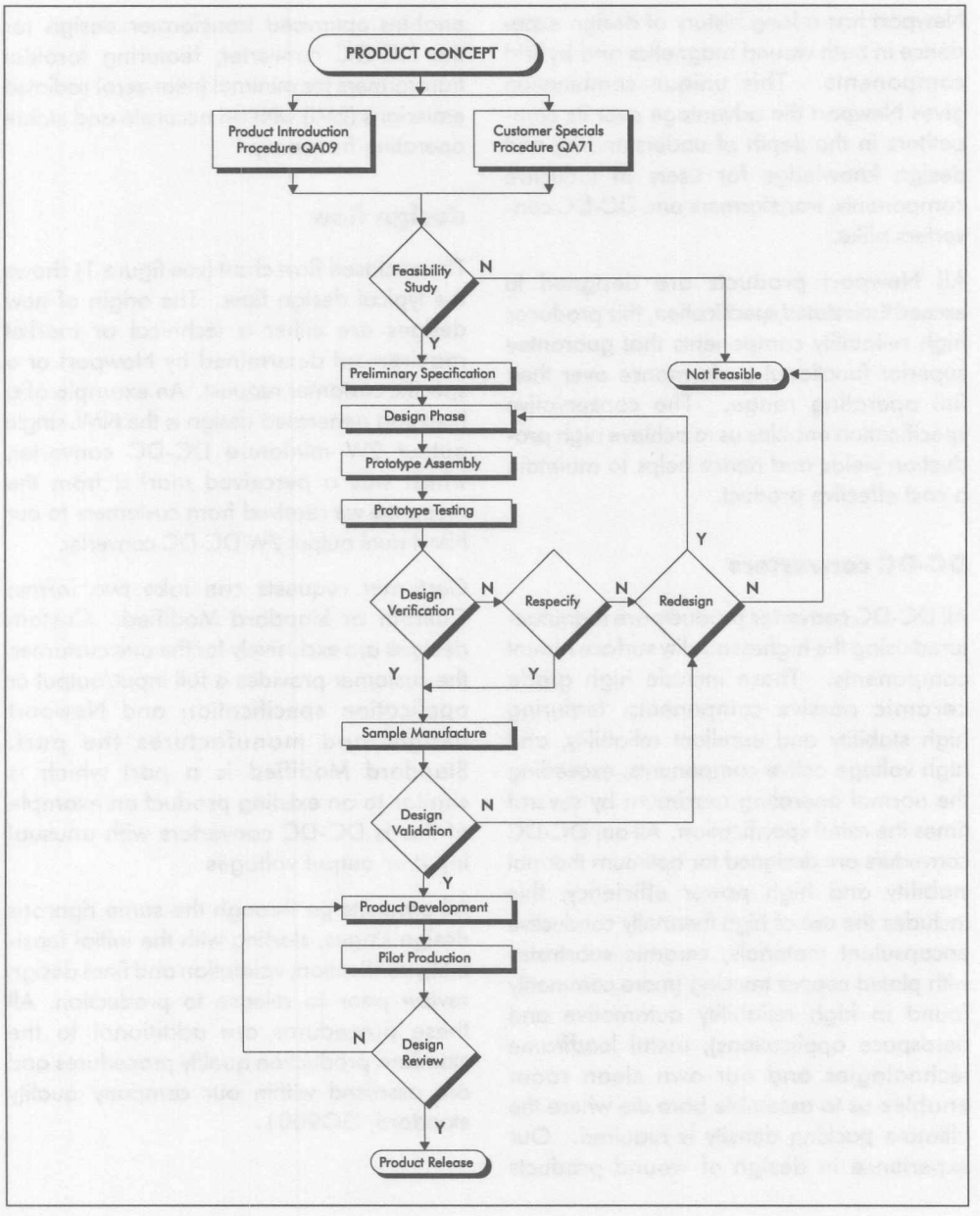

Figure 1 : *Typical Design Flow Chart*

applications

The design team at Newport has extensive experience of the use of our components in completed circuit designs. Many of these circuits are featured in the applications information included in this data book and some are published in the technical and trade press. We are always interested to hear from customers who have used our components to provide solutions to their circuit requirement and welcome their contributions to our application library, similarly if you require applications advice we are always prepared to provide this service

recommended solder reflow profiles

Newports range of products have been designed to withstand the majority of production soldering processes. All through hole parts are designed to withstand a maximum lead temperature of 300°C at 1.5mm from the case, all surface mount parts are designed to withstand a maximum reflow temperature of 280°C.

The above figures are the maximum figures the products are designed to withstand. The profiles in figures 2,3 & 4 are the recommended solder temperature time profiles determined in accordance with CECC 00802.

isolation safety standards

There are a number of safety standards throughout the world for the isolation of electrical circuits. The International Electrotechnical Committee (IEC) has attempted to harmonise the standards concerned with information technology equipment into a single standard; IEC 950. This standard has been adopted in most of the major market places and is becoming the world wide standard for safety of electrical equipment covering office equipment, data processing and telecommunications products (see Table 1).

Newport are a world wide supplier of components, many for isolation of electrical circuits. Where possible, Newport have adopted IEC950 as the safety standard against which to obtain component approval. As a European based manufacturer our approval certificates will list the European Norm standard (EN60950), however, this can be easily translated into other local standards due to its IEC lineage.

Newport use the British Standards Institute for all its approval testing.

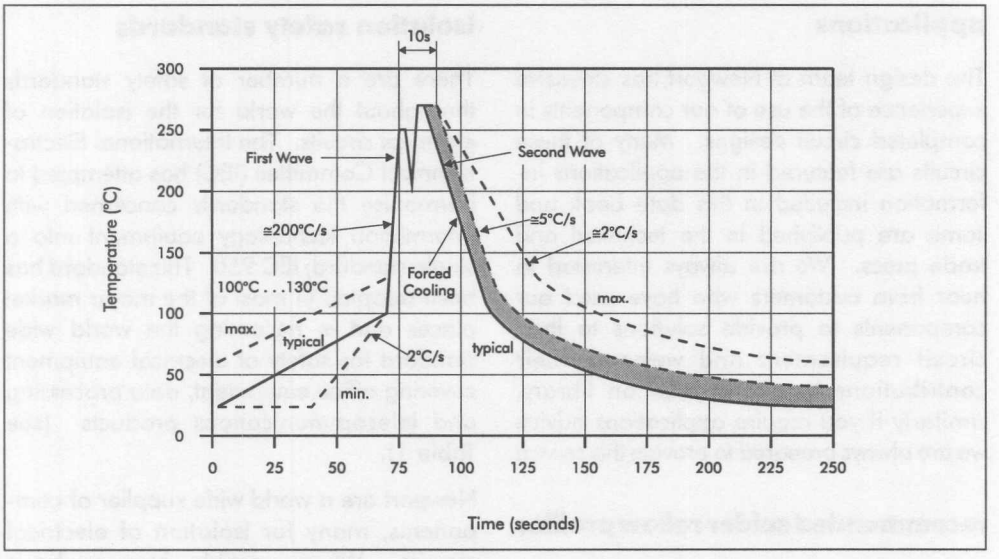

Figure 2 : *Double-Wave Soldering Profile (Lead Temperature) for Through Hole Parts*

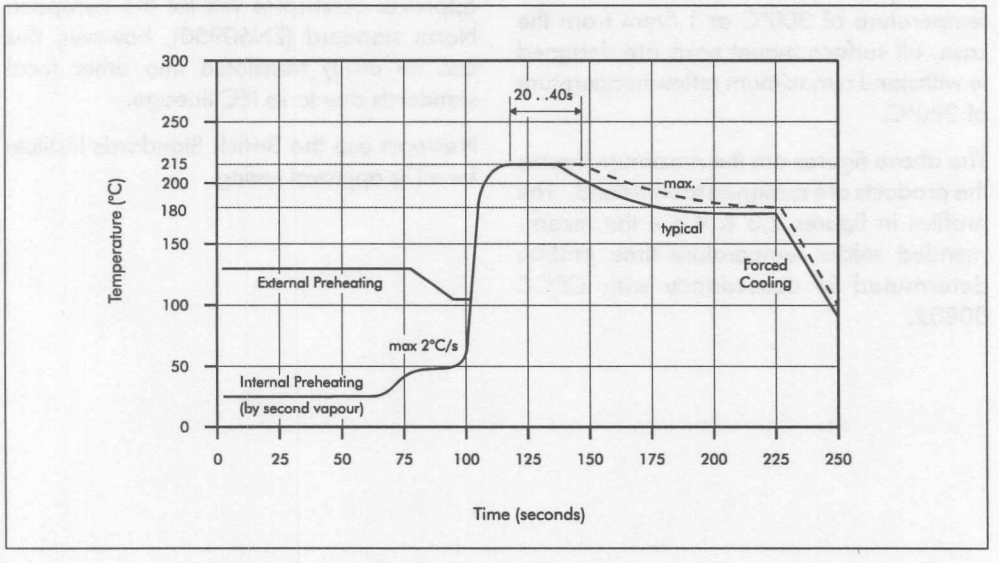

Figure 3 : *Vapour Phase Soldering Systems with Pre-Heating*

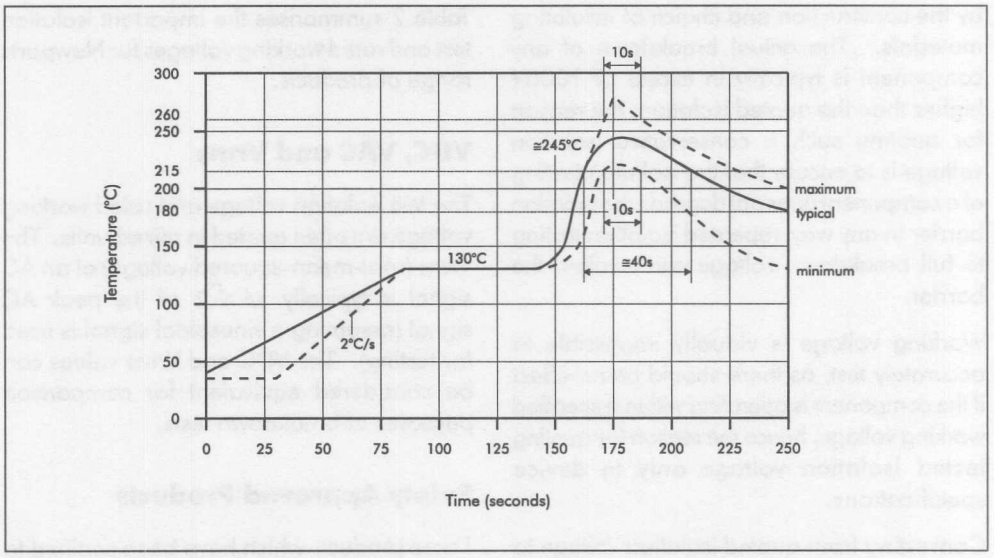

Figure 4 : *Infra-Red Soldering Systems*

Territory	Authority	Standard	Date
Europe	CENELEC	EN60950	September 1st 1991
USA	Underwriters Laboratory	UL1950	March 15th 1992
Canada	Canadian Standards Authority	CSA950	September 20th 1993

Table 1 : *Adoption of IEC950 Safety Standard*

isolation voltage and rated working voltage

Isolation Voltage is the voltage applied across the isolation barrier of the component under test (i.e. input to output for DC-DC converters, primary to secondary for transformers) for a fixed time period (typically 1 second). The test is a measure of the electrical strength of the insulating materials used in the component and is performed on all components prior to despatch.

Rated Working Voltage is the maximum continuous voltage that can be sustained across the isolation barrier of the component without causing stress to the isolation barrier. This is typically much lower than the isolation voltage.

Isolation voltage is designed into a product

by the construction and choice of insulating materials. The actual breakdown of any component is typically in excess of 1000V higher than the quoted isolation, the reason for quoting such a conservative isolation voltage is to ensure that the isolation testing of a component does not degrade the isolation barrier in any way, repeated isolation testing to full breakdown voltage can weaken the barrier.

Working voltage is virtually impossible to accurately test, as there should be no effect if the component is operating within a specified working voltage, hence the reason for quoting tested isolation voltage only in device specifications.

Converting from quoted isolation voltage to working voltage is a somewhat controversial matter as it depends greatly on the construction of the product. In approved products all parts have to have a specified internal clearance (i.e. physical separation) as well as using insulators. In commercial products often the isolation relies on the insulation properties of applied coatings (either insulation on wire or conformal coating on a PCB), hence the thickness of these coatings may be important as this defines the electrical field strength through the insulator.

At Newport we use the convention quoted in the IEC950 specification for safety of information technology equipment. This gives the information in a tabular form of test voltages against working voltage (see figure 5). This is an internationally recognised standard for estimating working voltages from quoted isolation voltage and is applicable to all Newport products.

Table 2 summarises the important isolation test and rated working voltages for Newports range of products.

VDC, VAC and Vrms

The test isolation voltage and rated working voltage are often quoted in mixed units. The Vrms (root-mean-squared voltage) of an AC signal is typically $1/\sqrt{2}$ of the peak AC signal (assuming a sinusoidal signal is used for testing). The VDC and Vrms values can be considered equivalent for comparison purposes of breakdown tests.

Safety Approved Products

Those products which have been certified to EN60950 safety standard for information technology equipment have been independently assessed for both isolation strength and physical separation within the component. All Newport products with EN60950 certification have a physical internal clearance between any conductor across the isolation barrier which is in excess of 2.0mm. The clearance distance is independent of insulator materials and coatings, including wire insulation and encapsulation material. In accordance with the international standard IEC950 this provides sufficient separation for safe working voltages of up to 300Vrms (420VAC).

Only those products which are certified to EN60950 have this guaranteed safety specification, all other components utilise the isolation strength of insulating materials to guarantee the isolation voltage.

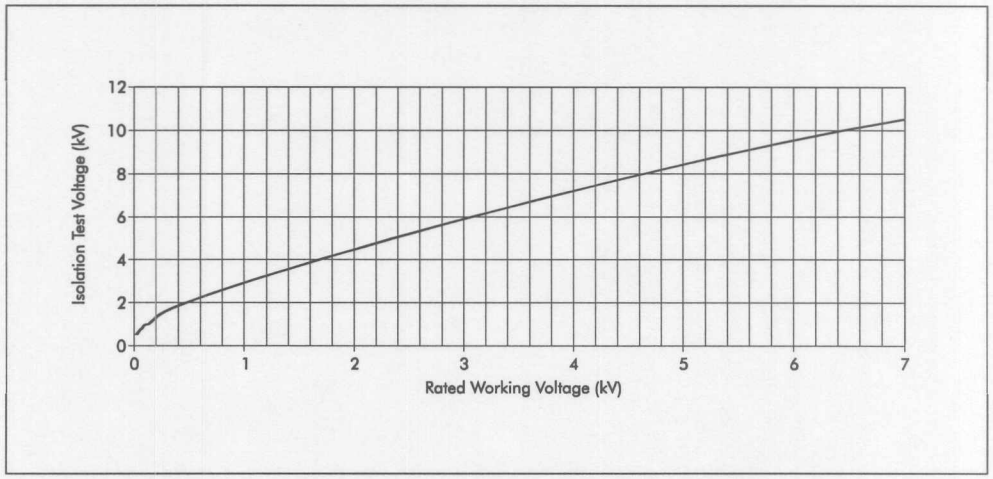

Figure 5 : *IEC950 Test Voltage for Electrical Strength Tests*

Isolation Test Voltage (Vrms)	Rated Working Voltage (Vrms)
1000	130
1500	230
3000	1100
6000	3050

Table 2 : *Adoption of IEC950 Safety Standard*

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DC-DC Converters

DC-DC Series	Parameters							Package Styles
	Output Power (max.)	Isolation Voltage	Output (S/D/T)[1]	Regulated/ Unregulated Output	Input Voltage	Output Voltage	Power Density (max.)	
LME	0.25	1000	S	U	3.3/5/12	3.3/5/9 12/15	0.36	SIP/DIP
NMA	1	1000	D	U	3.3/5/12 24/48	5/9/12/15	0.85	SIP/DIP
NMD	1	1000	T	U	5/12	3.3*/5*/9* 12*/15*	0.85	SIP/DIP
NME	1	1000	S	U	3.3/5/12 24/48	3.3/5/9 12/15	0.69	SIP/DIP
NMETM	1	1000	S	U	5/12	5/9/12/15	1.68	SOIC
NMF	1	1000	S	R	5/12/24/48	5/9/12/15	0.85	SIP/DIP /SM
NMV	1	3000	S/D	U	5/12/24/48	5/9/12/15	0.68	SIP/DIP
NMH	2	1000	D	U	5/12/24/48	5/9/12/15	1.42	SIP/DIP
NML	2	1000	S	U	5/12	5/9/12/15	2.01	SIP
NMS	2	6000	D	U	5/12	5/9/12/15	0.65	DIP
NMXSO	5	1000	S/D	R	5/12	5/12/15	0.53	DIP
NMXU	5	1000	S/D	U	5/12	5/12/15	0.85	DIP
Units	Watts	VDC			V	V	W/cc	

[1] S=Single, D=Dual, T=Twin

* Paired with 5V

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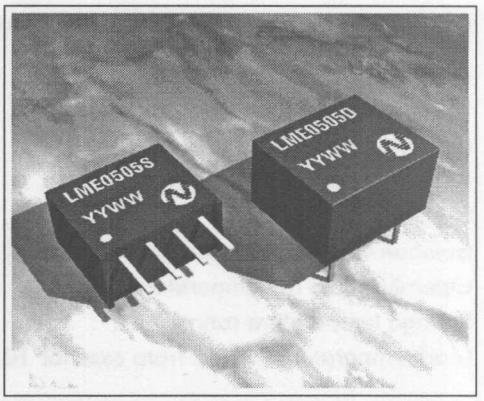
features

- High Efficiency for Low Power Applications
- Pin Compatible with NME & NML
- 1kVDC Isolation
- SIP & DIP Package Styles
- Single Output Rail
- Power Density 0.36W/cm^3
- 3.3V, 5V and 12V Input
- 3.3V, 5V, 9V, 12V and 15V Output
- Footprint from 0.69cm^2
- UL94-V0 Package
- No Heatsink Required
- Internal SMD Construction
- Toroidal Magnetics
- Fully Encapsulated
- No External Components Required
- MTTF up to 3.2 Million Hours
- PCB Mounting
- Custom Solutions Available

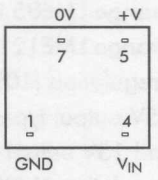
description

The LME series of DC-DC converters are optimised for low-power operation. Due to the low quiescent current they are able to offer efficiencies up to 75%. The use of advanced magnetics ensures a minimal quiescent current of around 2.5mA which ensures that efficiency is maximised in low power applications. They are ideally suited to generating a negative supply where only a positive rail exists.

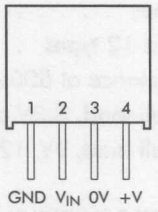


pin connections

8 Pin DIP (top view)



4 Pin SIP



absolute maximum ratings over operating free air* temperature range

Input voltage V_{IN} LME03 types	5V
Input voltage V_{IN} LME05 types	7V
Input voltage V_{IN} LME12 types	15V
Output power total	250mW
Short circuit duration	1s
Isolation voltage (flash tested for 1 second)	1000VDC
Operating free air temperature range	0°C to 70°C[1]
Storage temperature range	–55°C to 150°C
Lead temperature 1.5mm from case for 10 seconds	300°C

electrical specifications

(measured at T_A=25°C, at nominal input voltage)

Input voltage range LME03 types	3.3V±10%
Input voltage range LME05 types	5V±10%
Input voltage range LME12 types	12V±10%
Load voltage regulation (10% to 100% full load)	
3.3V and 5V output types	15% max.
9V, 12V and 15V output types	10% max.
Line voltage regulation (10% to 100% full load)	1.2%/1% of V_{IN}
Output voltage accuracy	See tolerance envelope graph
Input reflected ripple (20MHz Band limited)	
LME03 types	50mV p-p max.
LME05 and 12 types	40mV p-p max.
Output ripple (20MHz Band limited)	
LME03 types	75mV p-p max.
LME05 and 12 types	100mV p-p max.
Insulation resistance at 500VDC	1000 MΩ min.
Efficiency at full load, 3.3V and 5V output types	70% typical 60% min.
Efficiency at full load, 9V, 12V and 15V output types	75% typical 70% min.

* Free air – requires a minimum of 10mm air space around the component.

[1] See derating curve.

electrical specifications

(measured at T_A=25°C, at nominal input voltage)

Temperature drift (V_{OUT}) . . . . . 0.03% per °C max.
Temperature rise above ambient at full load . . . . . 10°C max.
Weight SIP types (typical) . . . . . 1.4 grams
Weight DIP types (typical) . . . . . 1.5 grams
Switching frequency at full load (typical) 100kHz
No load power consumption (typical), LME03 types 50mW
No load power consumption (typical), LME05 and 12 types 30mW

selection guide

3.3V, 5V and 12V input types

Part Number	Output Voltage (V)	Output Current (mA)	Package Style
LMEXX05D	5	50	1
LMEXX09D	9	28	
LMEXX12D	12	21	
LMEXX15D	15	16	
LMEXX05S	5	50	2
LMEXX09S	9	28	
LMEXX12S	12	21	
LMEXX15S	15	16	

selection guide

LME0503

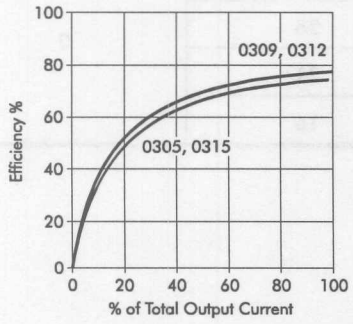
Part Number	Output Voltage (V)	Output Current (mA)	Package Style
LME0503D	3.3	76	1
LME0503S			2

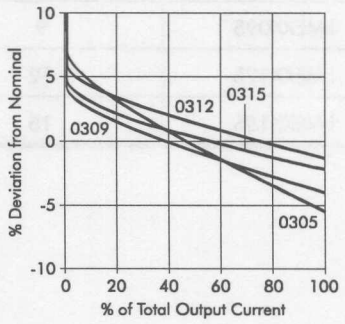
typical isolation capacitance (pF)

Part Number	Output Voltage (V)				
	03	05	09	12	15
LME03XX	–	25	30	38	38
LME05XX	25	29	37	41	40
LME12XX	–	38	40	43	45

typical characteristics

LME03 series

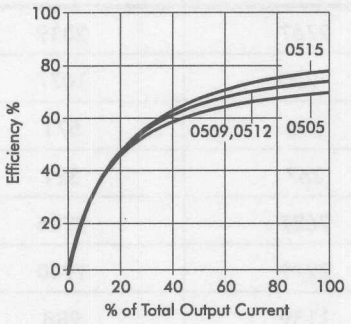


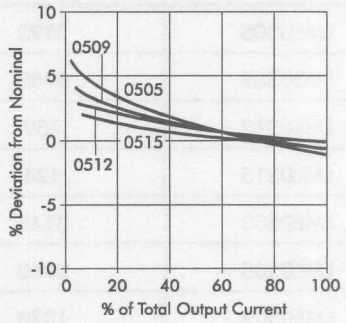


Note : All data taken at T_A=25°C.

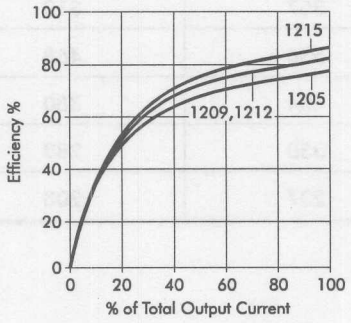
typical characteristics

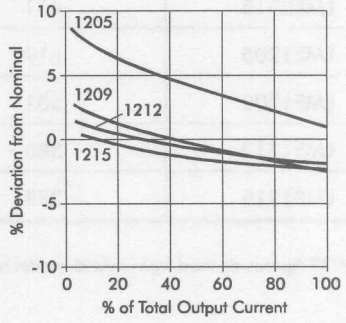
LME05 series



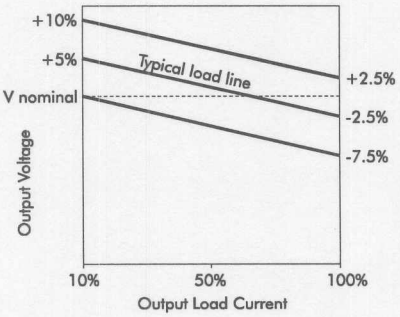


LME12 series

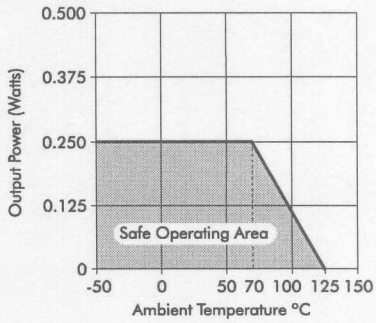




tolerance envelope



temperature derating graph



Note : All data taken at T_A=25°C.

See application notes on page 2-114

mean time to failure (MTTF) in thousands of hours

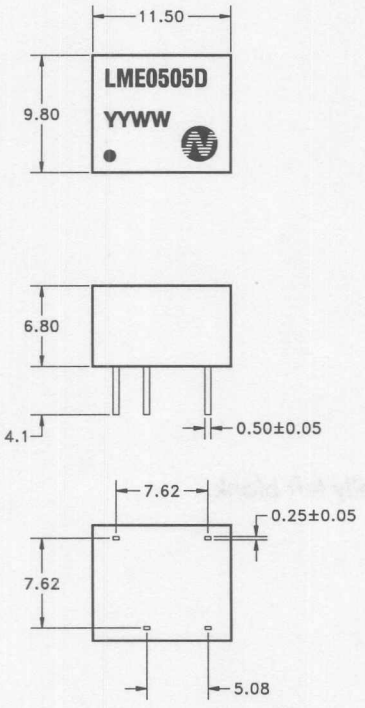
Part Number	–25°C	25°C	70°C
LME0305	3293	2767	2319
LME0309	1459	1250	1077
LME0312	759	655	571
LME0315	424	367	321
LME0503	3145	2637	2204
LME0505	2660	2279	1940
LME0509	1320	1139	988
LME0512	720	624	545
LME0515	411	357	313
LME1205	619	536	468
LME1209	501	434	380
LME1212	380	330	289
LME1215	273	237	208

Note : MTTF figures derived from hybrid model of MIL-HDBK-217F.

outline dimensions

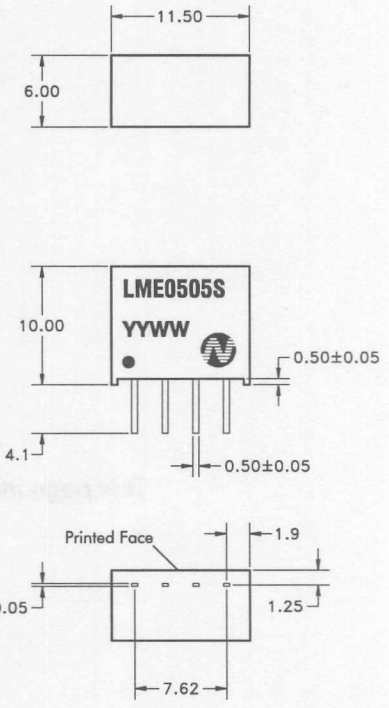
8 Pin DIP package style

1

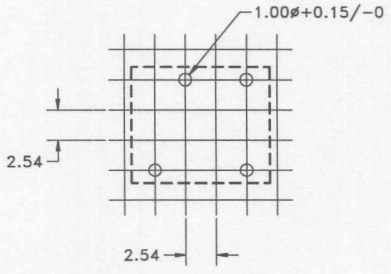


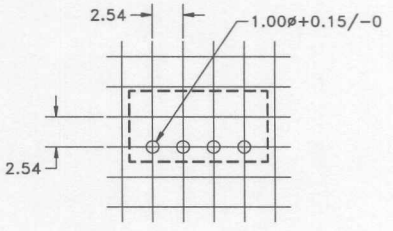
4 Pin SIP package style

2



recommended footprint details





All pins on a 2.54mm pitch.
All dimensions in mm XX.X ±0.50, XX.XX ±0.25

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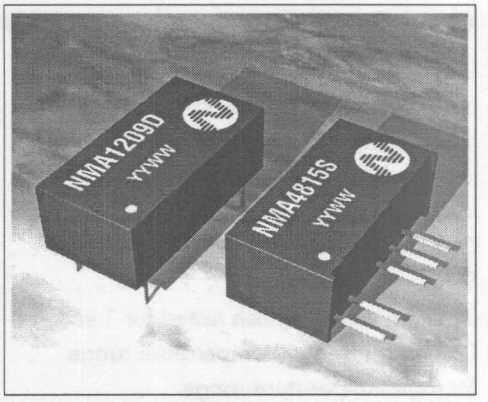
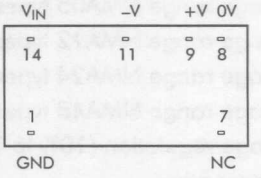
features

- Dual Output from a Single Input Rail
- Pin Compatible with NMH
- Industry Standard Pinout
- Power Sharing on Output
- 1kVDC Isolation
- SIP & DIP Package Styles
- Efficiency to 80%
- Power Density 0.85W/cm^3
- 3.3V, 5V, 12V, 24V & 48V Input
- 5V, 9V, 12V and 15V Output
- Footprint from 1.17cm^2
- UL94-V0 Package
- No Heatsink Required
- Internal SMD Construction
- Toroidal Magnetics
- Fully Encapsulated
- No External Components Required
- MTTF up to 2.1 Million hours
- PCB Mounting
- Custom Solutions Available

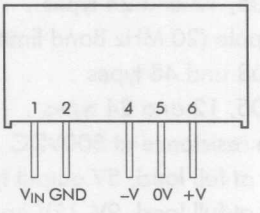


pin connections

14 Pin DIP (top view)



7 Pin SIP



description

The NMA series of DC-DC converters are the standard building blocks for on-board distributed power systems. They are ideally suited to providing dual rail supplies on primarily digital boards with the added benefit of galvanic isolation to reduce switching noise. All of the rated power may be drawn from a single pin provided the total load does not exceed 1 Watt.

absolute maximum ratings over operating free air* temperature range

Input voltage V_{IN} NMA03 types	5V
Input voltage V_{IN} NMA05 types	7V
Input voltage V_{IN} NMA12 types	15V
Input voltage V_{IN} NMA24 types	28V
Input voltage V_{IN} NMA48 types	54V
Output power total	1W
Short-circuit duration	1s
Isolation voltage (flash tested for 1 second)	1000VDC
Operating free air temperature range	0°C to 70°C[1]
Storage temperature range	–55°C to 150°C
Lead temperature 1.5mm from case for 10 seconds	300°C

electrical specifications

(measured at T_A=25°C, at nominal input voltage)

Input voltage range NMA03 types	3.3V±10%
Input voltage range NMA05 types	5V±10%
Input voltage range NMA12 types	12V±10%
Input voltage range NMA24 types	24V±10%
Input voltage range NMA48 types	48V±10%
Load voltage regulation (10% to 100% full load)	
5V output types	15% max.
9V, 12V and 15V output types	10% max.
Line voltage regulation (10% to 100% full load)	1.2%/1% of V_{IN}
Output voltage accuracy	See tolerance envelope graph
Input reflected ripple (20 MHz Band limited)	
NMA03 and 48 types	100mV p-p max.
NMA05, 12 and 24 types	80mV p-p max.
Output ripple (20 MHz Band limited)	
NMA03 and 48 types	150mV p-p max.
NMA05, 12 and 24 types	75mV p-p max.
Insulation resistance at 500VDC	1000MΩ min.
Efficiency at full load, 5V output types	70% typical 65% min.
Efficiency at full load, 9V, 12V and 15V output types	80% typical 70% min.

* Free air – requires a minimum of 10mm air space around the component. [1] See derating curve.

electrical specifications

(measured at T_A=25°C, at nominal input voltage)

Temperature drift (V_{OUT}) . . . . . 0.03% per °C max.
Temperature rise above ambient at full load . . . . . 10°C max.
Weight NMA03/05/12/24 DIP and SIP types (typical) . . . . . 2.3 grams
Weight NMA48 DIP and SIP types (typical) . . . . . 2.9 grams
Switching frequency at full load (typical) 100kHz
No load power consumption (typical) 100mW

selection guide

3.3V, 5V, 12V and 24V input types

Part Number	Output Voltage (V)	Output Current Each Output (mA)	Package Style
NMAXX05D	±5	100	1
NMAXX09D	±9	56	
NMAXX12D	±12	42	
NMAXX15D	±15	34	
NMAXX05S	±5	100	3
NMAXX09S	±9	56	
NMAXX12S	±12	42	
NMAXX15S	±15	34	

selection guide

48V input types

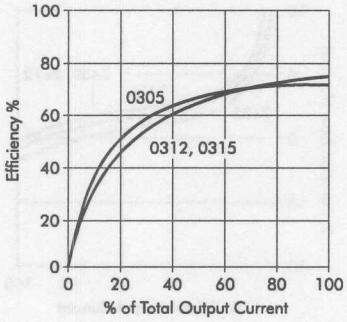
Part Number	Output Voltage (V)	Output Current Each Output (mA)	Package Style
NMA4805D	±5	100	2
NMA4809D	±9	56	
NMA4812D	±12	42	
NMA4815D	±15	34	
NMA4805S	±5	100	4
NMA4809S	±9	56	
NMA4812S	±12	42	
NMA4815S	±15	34	

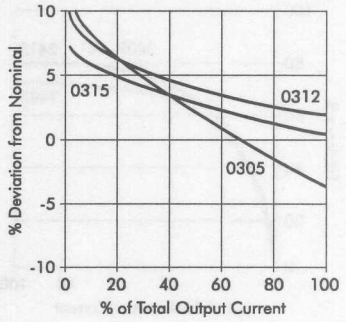
typical isolation capacitance (pF)

Part Number	Output Voltage (V)			
	05	09	12	15
NMA03XXX	23	25	21	23
NMA05XXX	18	25	26	32
NMA12XXX	33	40	57	60
NMA24XXX	39	50	65	95
NMA48XXX	26	38	52	56

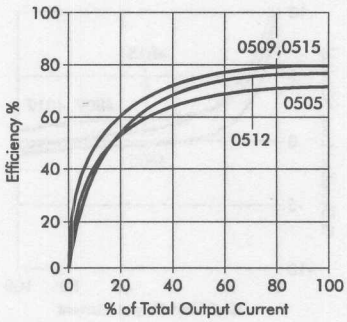
typical characteristics

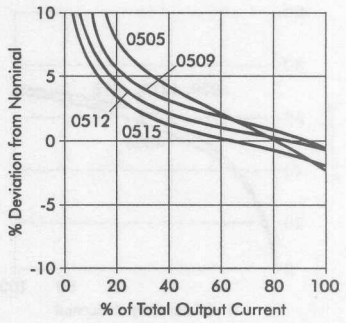
NMA03 series



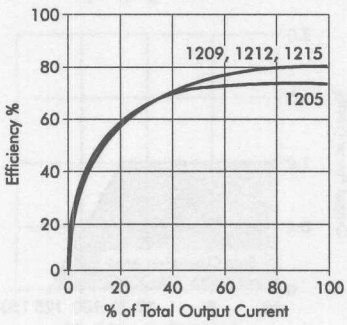


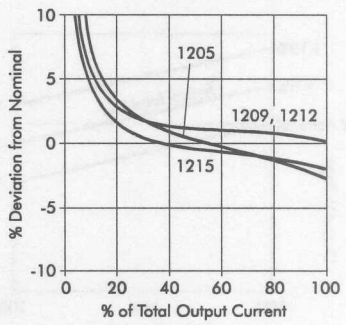
NMA05 series





NMA12 series

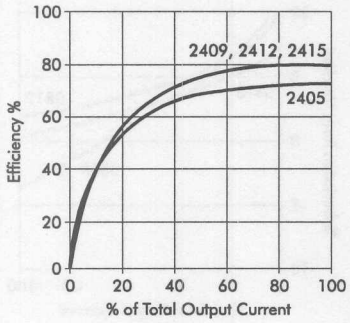


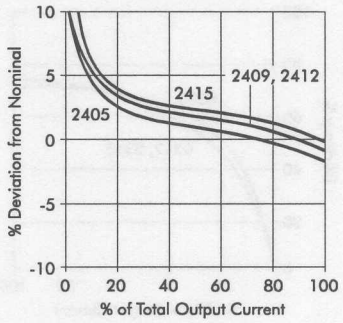


Note : All data taken at T_A=25°C.

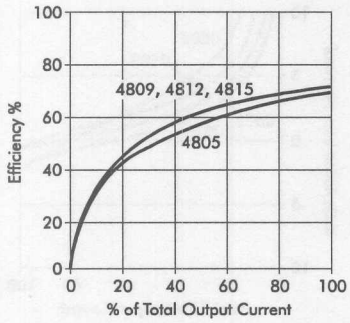
typical characteristics

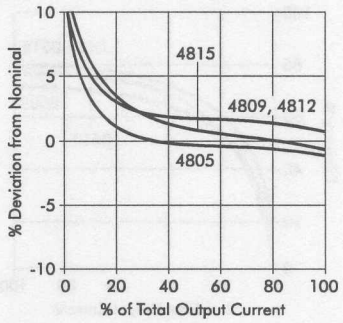
NMA24 series



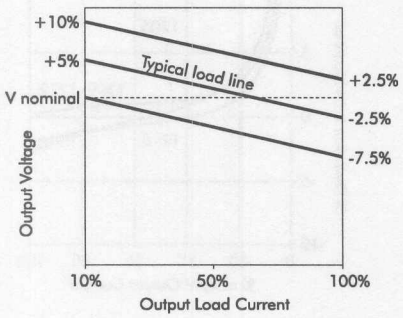


NMA48 series

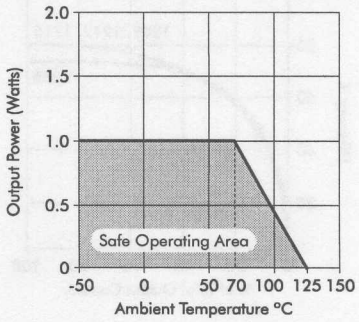




tolerance envelope



temperature derating graph

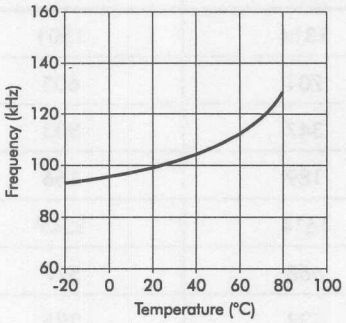


See application notes on page 2-114

Note : All data taken at T_A=25°C.

typical characteristics

temperature test (under full load)



Note : All data taken at T_A=25°C.

mean time to failure (MTTF) in thousands of hours

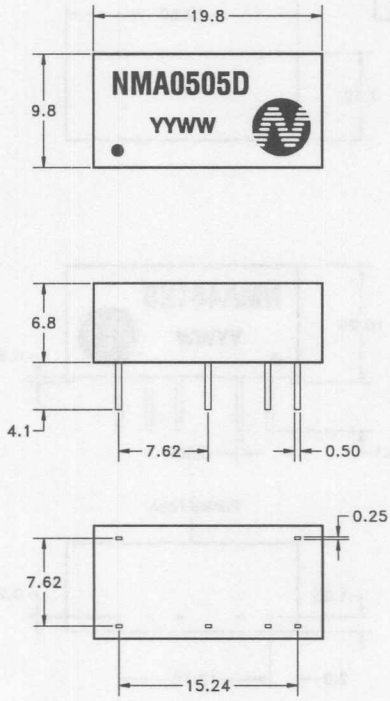
Part Number	–25°C	25°C	70°C
NMA0305	2182	1814	1501
NMA0309	819	701	603
NMA0312	403	347	303
NMA0315	219	189	166
NMA0505	1899	1614	1349
NMA0509	774	668	577
NMA0512	391	338	295
NMA0515	215	186	163
NMA1205	566	488	423
NMA1209	395	342	298
NMA1212	263	228	199
NMA1215	169	147	129
NMA2405	224	194	170
NMA2409	191	166	145
NMA2412	154	134	117
NMA2415	117	101	89
NMA4805	237	206	180
NMA4809	201	174	153
NMA4812	166	139	122
NMA4815	120	104	92

Note : MTTF figures derived from hybrid model of MIL-HDBK-217F.

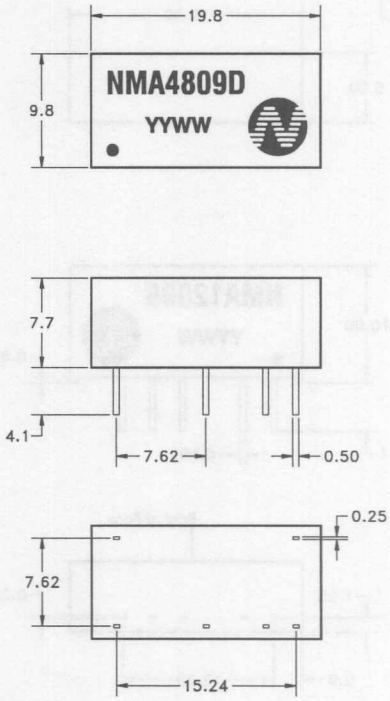
outline dimensions

14 Pin DIP package styles

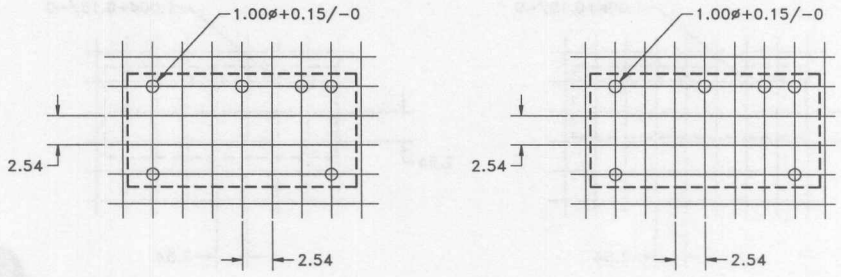
1



2



recommended footprint details



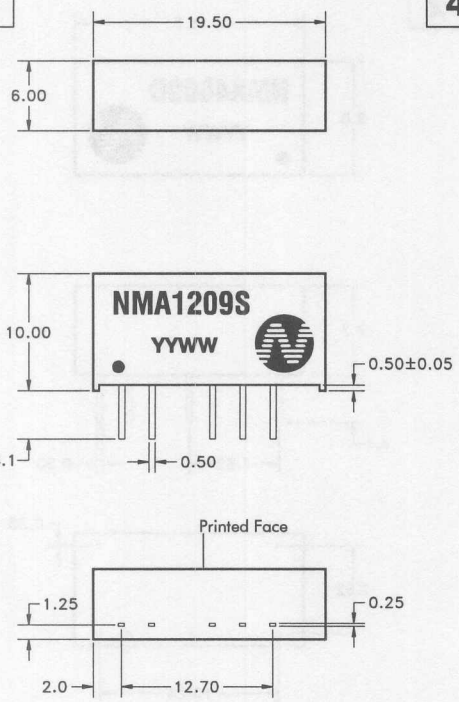
All pins on a 2.54mm pitch.

All dimensions in mm XX.X ±0.50, XX.XX ±0.25

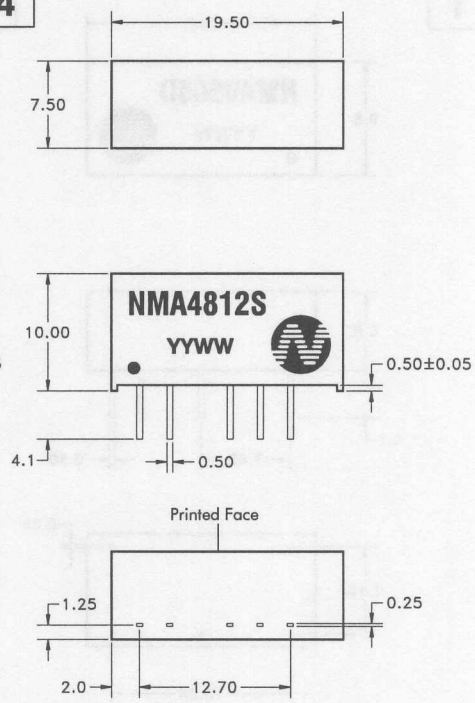
outline dimensions

7 Pin SIP package styles

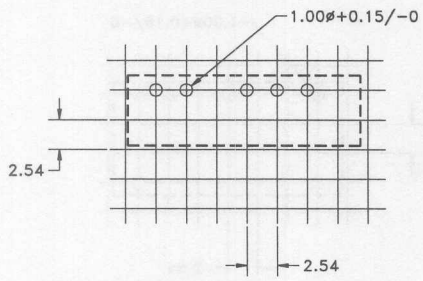
3

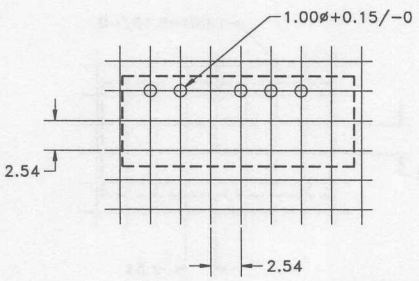


4



recommended footprint details





All pins on a 2.54mm pitch.
All dimensions in mm XX.X ±0.50, XX.XX ±0.25

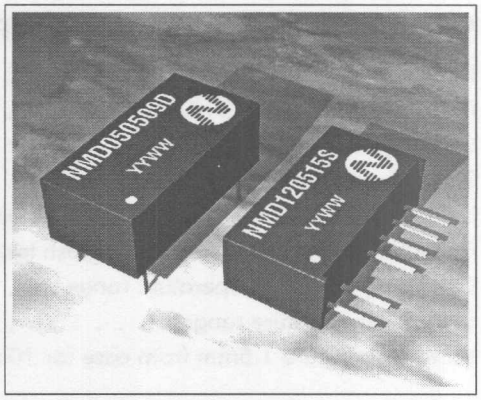
newport technology

features

- Twin Independent Outputs
- Output/Output Isolation 1kVDC
- Power Sharing on Outputs
- Input/Output Isolation 1kVDC
- SIP & DIP Package Styles
- Efficiency to 80%
- Power Density 0.85W/cm^3
- 5V & 12V Input
- One 5V Output (V1)
- 3.3V, 5V, 9V, 12V and 15V Output (V2)
- Footprint from 1.17cm^2
- UL94-V0 Package
- No Heatsink Required
- Internal SMD Construction
- Toroidal Magnetics
- Fully Encapsulated
- No External Components Required
- MTTF up to 1.9 Million hours
- PCB Mounting
- Custom Solutions Available

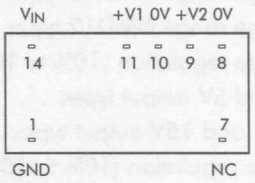
description

The NMD series of DC-DC converters are ideally suited to applications where a potential difference exists between loads, eg motor control circuits. The twin outputs offer cost and space savings by consolidating two DC-DC Converters into one package. All of the rated power may be drawn from a single output provided the total load does not exceed 1 Watt.

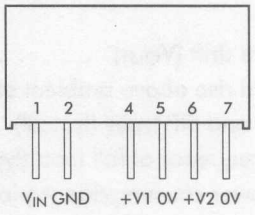


pin connections

14 Pin DIP (top view)



7 Pin SIP



absolute maximum ratings over operating free air* temperature range

Input voltage V_{IN} NMD05 types	7V
Input voltage V_{IN} NMD12 types	15V
Output power total	1W
Short-circuit duration	1s
Input to output Isolation voltage (flash tested for 1 second)	1000VDC
Output to output Isolation voltage (flash tested for 1 second)	1000VDC
Operating free air temperature range	0°C to 70°C[1]
Storage temperature range	–55°C to 150°C
Lead temperature 1.5mm from case for 10 seconds	300°C

electrical specifications

(measured at T_A=25°C, at nominal input voltage)

Input voltage range NMD05 types	5V±10%
Input voltage range NMD12 types	12V±10%
Load voltage regulation (10% to 100% full load)	
3.3V and 5V output types	15% max.
9V, 12V and 15V output types	10% max.
Line voltage regulation (10% to 100% full load)	1.2%/1% of V_{IN}
Output voltage accuracy	See tolerance envelope graph
Input reflected ripple (20 MHz Band limited)	80mV p-p max.
Output ripple (20 MHz Band limited)	75mV p-p max.
Insulation resistance at 500VDC	1000MΩ min.
Efficiency at full load, 3.3V, 5V output type	70% typical 65% min.
Efficiency at full load, 9V, 12V and 15V types	80% typical 70% min.
Temperature drift (V_{OUT})	0.03% per °C max.
Temperature rise above ambient at full load	8°C max.
Weight DIP and SIP types (typical)	2.3 grams
Switching frequency at full load (typical)	100kHz
No load power consumption (typical)	100mW

* Free air – requires a minimum of 10mm air space around the component.

[1] See derating curve.

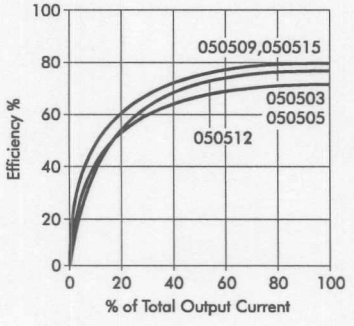
selection guide

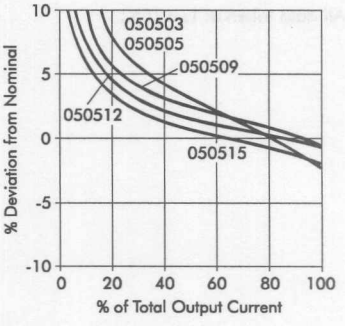
5V, 12V input types

Part Number	Output Voltage 1 (V)	Output Voltage 2 (V)	Output Current 1 (mA)	Output Current 2 (mA)	Package Style
NMDXX0503D	5	3.3	100	152	1
NMDXX0505D	5	5	100	100	
NMDXX0509D	5	9	100	56	
NMDXX0512D	5	12	100	42	
NMDXX0515D	5	15	100	34	
NMDXX0503S	5	3.3	100	152	2
NMDXX0505S	5	5	100	100	
NMDXX0509S	5	9	100	56	
NMDXX0512S	5	12	100	42	
NMDXX0515S	5	15	100	34	

typical characteristics

NMD05 series

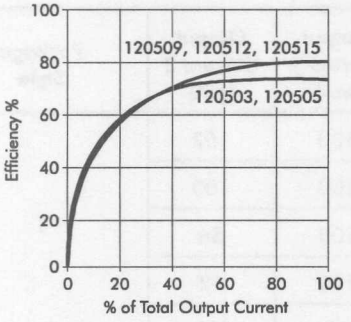


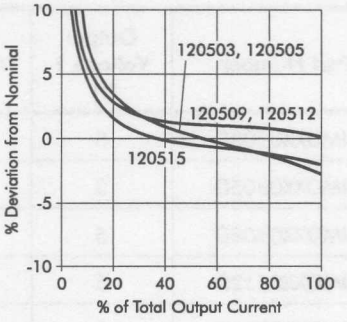


Note : All data taken at T_A =25°C.

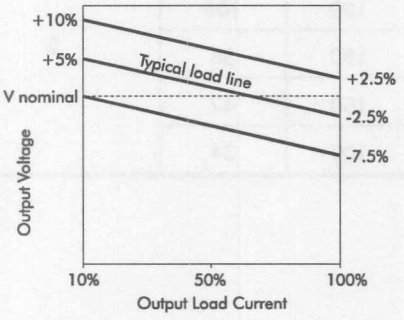
typical characteristics

NMD12 series

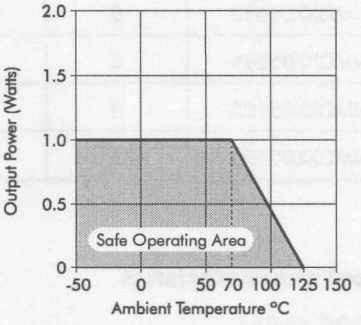




tolerance envelope



temperature derating graph



See application notes on page 2-114

Note : All data taken at T_A=25°C.

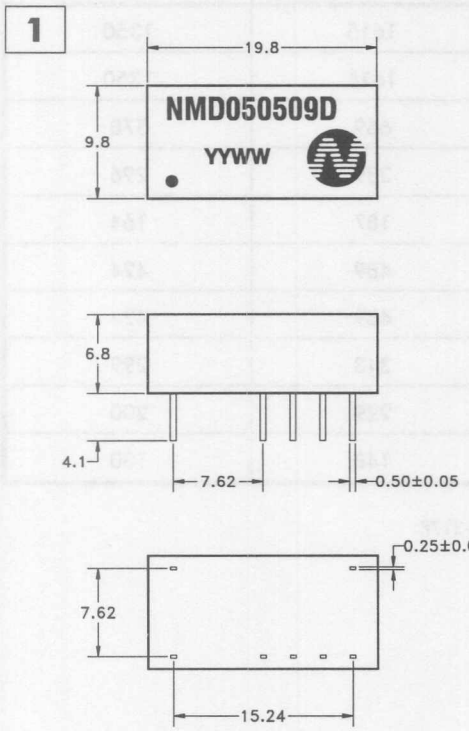
mean time to failure (MTTF) in thousands of hours

Part Number	–25°C	25°C	70°C
NMD050503	1900	1615	1350
NMD050505	1900	1615	1350
NMD050509	775	669	578
NMD050512	392	339	296
NMD050515	216	187	164
NMD120503	567	489	424
NMD120505	567	489	424
NMD120509	396	343	299
NMD120512	264	229	200
NMD120515	170	148	130

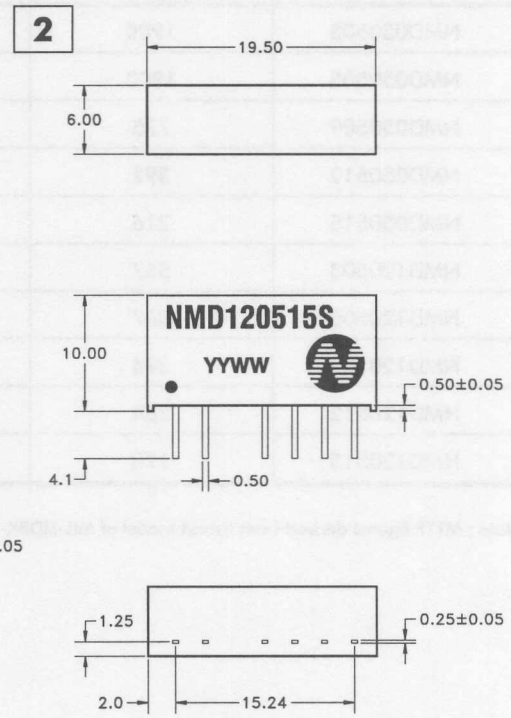
Note : MTTF figures derived from hybrid model of MIL-HDBK-217F.

outline dimensions

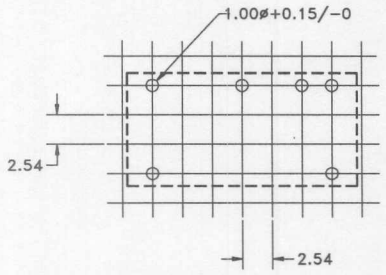
14 Pin DIP package style

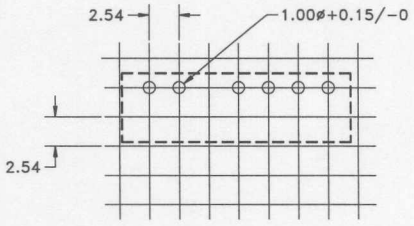


7 Pin SIP package style



recommended footprint details



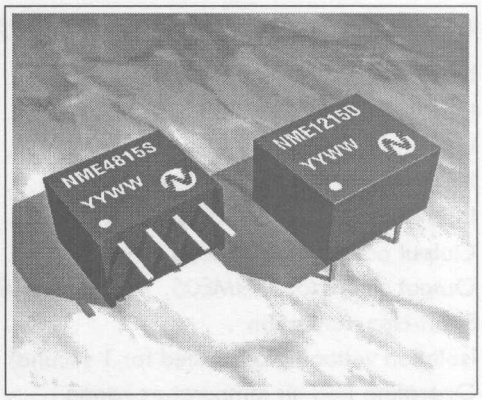


All pins on a 2.54mm pitch.
All dimensions in mm XX.X ±0.50, XX.XX ±0.25

newport technology

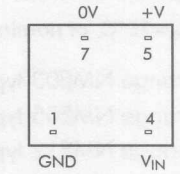
features

- Single Isolated Output
- 1kVDC Isolation
- Pin Compatible with LME & NML
- SIP & DIP Package Styles
- Efficiency to 75%
- Power Density 1.45W/cm^3
- 3.3V, 5V, 12V,15V, 24V & 48V Input
- 3.3V, 5V, 9V, 12V and 15V Output
- Footprint from 0.69 cm^2
- UL94-V0 Package
- No Heatsink Required
- Internal SMD Construction
- Toroidal Magnetics
- Fully Encapsulated
- No External Components Required
- MTTF up to 3.2 Million Hours
- PCB Mounting
- Custom Solutions Available

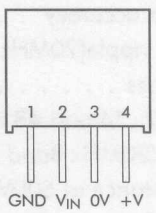


pin connections

8 Pin DIP (top view)



4 Pin SIP



description

The NME Series of DC-DC Converters is particularly suited to isolating and/or converting DC power rails. The galvanic isolation allows the device to be configured to provide an isolated negative rail in systems where only positive rails exist.

absolute maximum ratings over operating free air* temperature range

Input voltage V_{IN} NME03 types	5V
Input voltage V_{IN} NME05 types	7V
Input voltage V_{IN} NME12 types	15V
Input voltage V_{IN} NME24 types	28V
Input voltage V_{IN} NME48 types	54V
Output power total, NME03 types	500mW
Output power total, NME05, 12, 24 and 48 types	1W
Short-circuit duration	1s
Isolation voltage (flash tested for 1 second)	1000VDC
Operating free air temperature range	0°C to 70°C[1]
Storage temperature range	–55°C to 150°C
Lead temperature 1.5mm from case for 10 seconds	300°C

electrical specifications

(measured at T_A=25°C, at nominal input voltage)

Input voltage range NME03 types	3.3V±10%
Input voltage range NME05 types	5V±10%
Input voltage range NME12 types	12V±10%
Input voltage range NME24 types	24V±10%
Input voltage range NME48 types	48V±10%
Load voltage regulation (10% to 100% full load)	
3.3V and 5V output types	15% max.
9V, 12V and 15V output types	10% max.
Line voltage regulation (10% to 100% full load)	1.2%/1% of V_{IN}
Output voltage accuracy	See tolerance envelope graph
Input reflected ripple(20MHz Band limited)	
NME03 types	100mV p-p max.
NME05, 12, 24 and 48 types	90mV p-p max.
Output ripple (20MHz Band limited)	150mV p-p max.
Insulation resistance at 500VDC	1000 MΩ min.
Efficiency at full load, 3.3V and 5V output types	70% typical 65% min.
Efficiency at full load, 9V, 12V and 15V output types	75% typical 70% min.

* Free air – requires a minimum of 10mm air space around the component. [1] See derating curve.

electrical specifications

(measured at T_A=25°C, at nominal input voltage)

Temperature drift (V_{OUT}) . . . . . 0.03% per °C max.
Temperature rise above ambient at full load . . . . . 20°C max.
Weight SIP types (typical) . . . . . 1.4 grams
Weight DIP types (typical) . . . . . 1.5 grams
Switching frequency at full load (typical) 100kHz
No load power consumption (typical), NME03 types 75mW
No load power consumption (typical), NME05, 12, 24 and 48 types 100mW

selection guide

3.3V input types

Part Number	Output Voltage (V)	Output Current (mA)	Package Style
NME0305D	5	100	1
NME0309D	9	56	
NME0312D	12	42	
NME0315D	15	34	
NME0305S	5	100	3
NME0309S	9	56	
NME0312S	12	42	
NME0315S	15	34	

NME0503

Part Number	Output Voltage (V)	Output Current (mA)	Package Style
NME0503D	3.3	154	1
NME0503S			3

selection guide

5V, 12V and 24V input types

Part Number	Output Voltage (V)	Output Current (mA)	Package Style
NMEXX05D	5	200	1
NMEXX09D	9	110	
NMEXX12D	12	84	
NMEXX15D	15	67	
NMEXX05S	5	200	3
NMEXX09S	9	110	
NMEXX12S	12	84	
NMEXX15S	15	67	

48V input types

Part Number	Output Voltage (V)	Output Current (mA)	Package Style
NME4805D	5	200	2
NME4809D	9	110	
NME4812D	12	84	
NME4815D	15	67	
NME4805S	5	200	4
NME4809S	9	110	
NME4812S	12	84	
NME4815S	15	67	

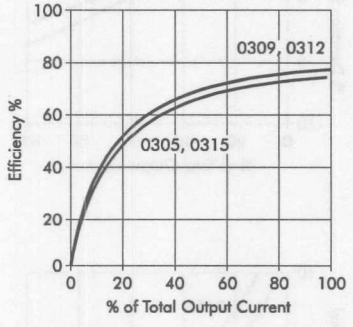
typical isolation capacitance (pF)

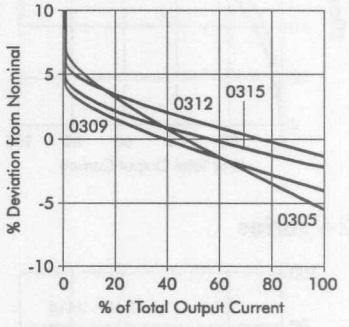
Part Number	Output Voltage (V)				
	3.3	05	09	12	15
NME03XXX	-	21	23	25	25
NME05XXX	21	24	32	26	32
NME12XXX	-	33	51	59	61
NME24XXX	-	40	59	78	79
NME48XXX	-	32	50	76	75

Note : All data taken at T_A=25°C.

typical characteristics

NME03 series

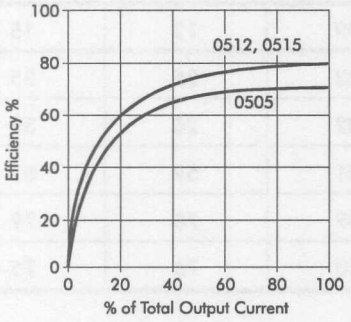


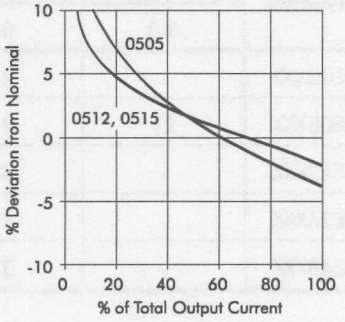


Note : All data taken at T_A=25°C.

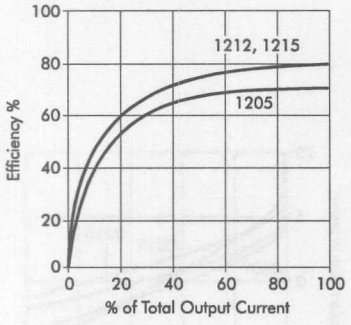
typical characteristics

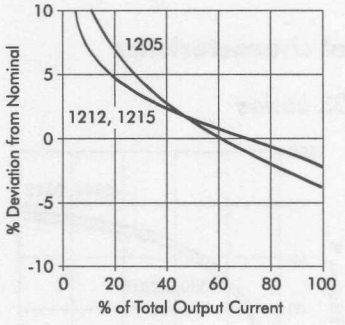
NME05 series



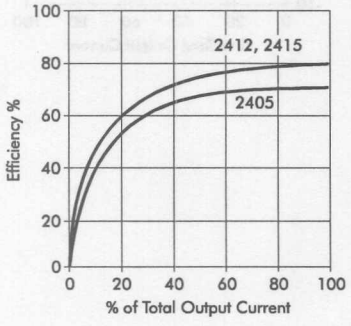


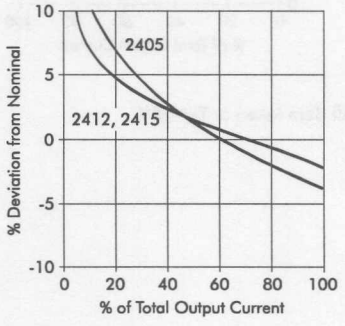
NME12 series





NME24 series

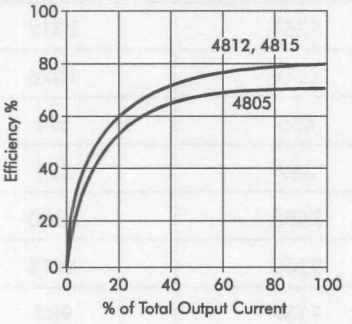


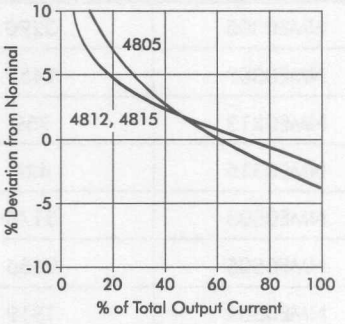


Note : All data taken at T_A=25°C.

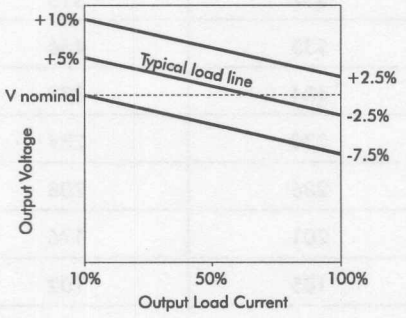
typical characteristics

NME48 series

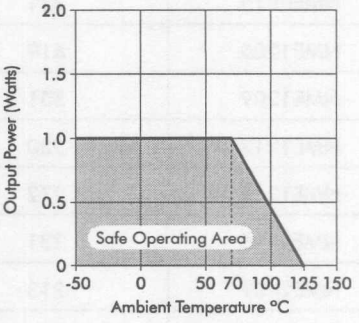




tolerance envelope

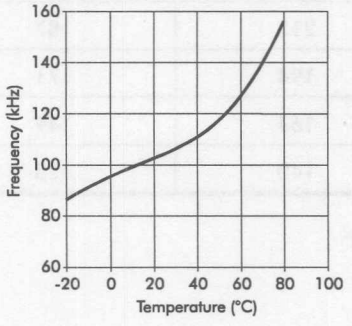


temperature derating graph



See application notes on page 2-114

temperature test (under full load)



Note : All data taken at T_A=25°C.

mean time to failure (MTTF) in thousands of hours

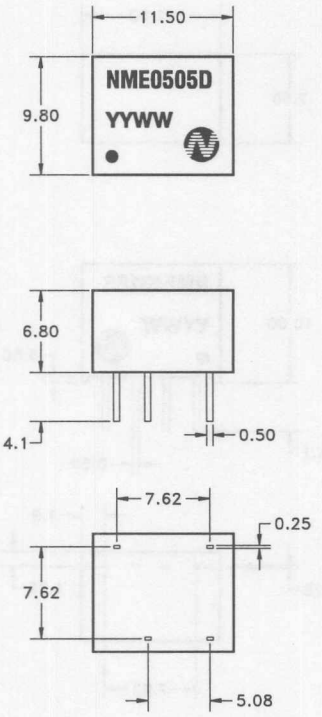
Part Number	–25°C	25°C	70°C
NME0305	3290	2761	2312
NME0309	1459	1249	1076
NME0312	759	655	571
NME0315	424	367	321
NME0503	3176	2693	2250
NME0505	2656	2265	1915
NME0509	1319	1137	984
NME0512	720	623	544
NME0515	411	357	313
NME1205	619	535	466
NME1209	501	434	379
NME1212	380	330	289
NME1215	272	236	208
NME2405	231	201	176
NME2409	213	185	102
NME2412	187	163	143
NME2415	157	136	120
NME4805	246	213	187
NME4809	224	194	171
NME4812	195	164	149
NME4815	161	140	123

Note : MTTF figures derived from hybrid model of MIL-HDBK-217F.

outline dimensions

8 Pin DIP package styles

1



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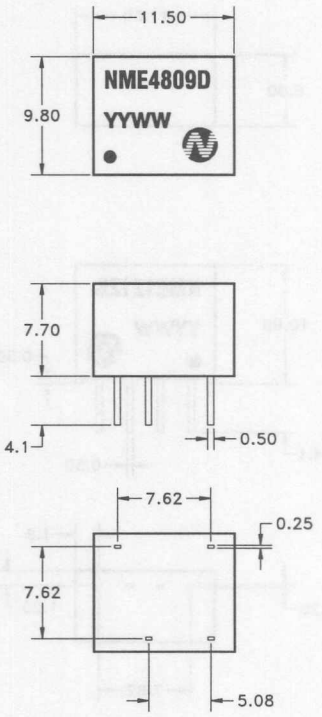
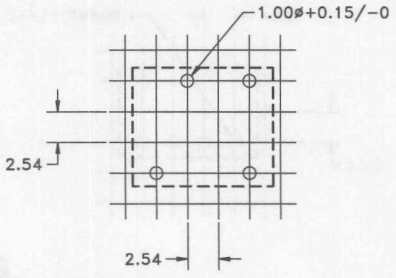
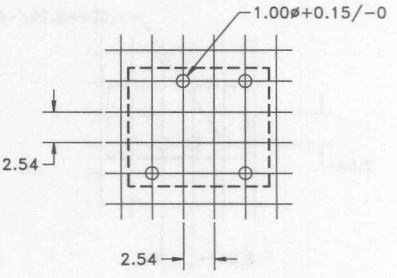


recommended footprint details





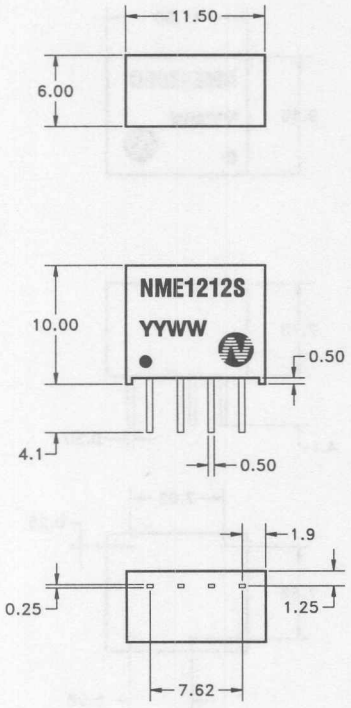
All pins on a 2.54mm pitch.

All dimensions in mm XX.X ±0.50, XX.XX ±0.25

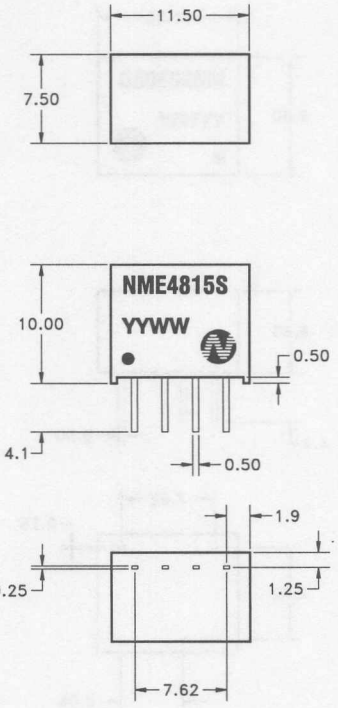
outline dimensions

4 Pin SIP package styles

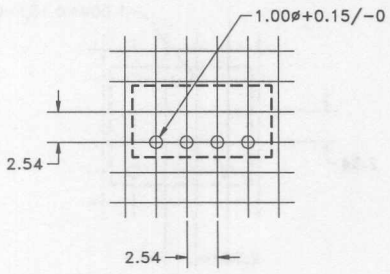
3

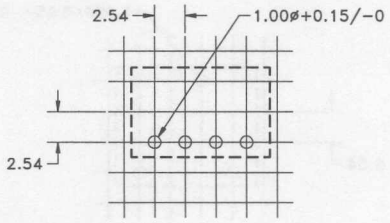


4



recommended footprint details

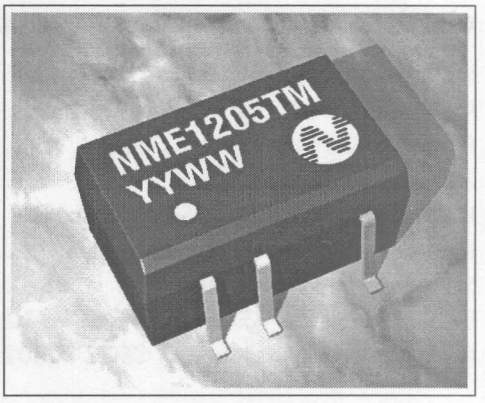




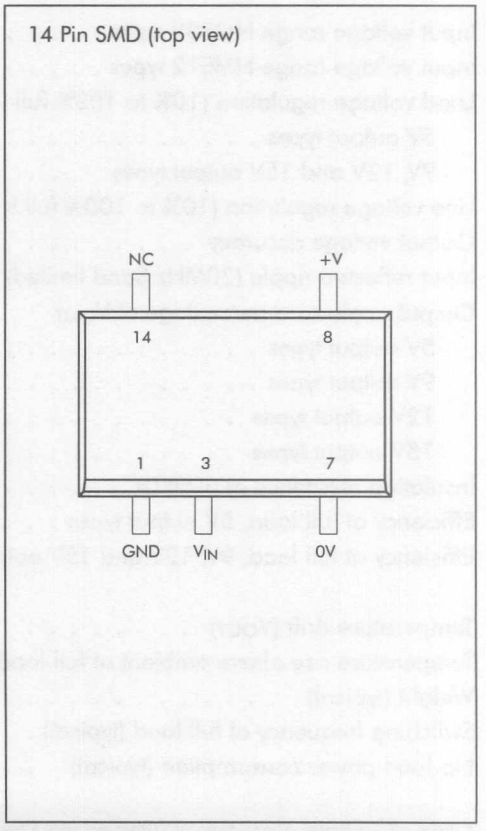
All pins on a 2.54mm pitch.
All dimensions in mm XX.X ±0.50, XX.XX ±0.25

features

- Lead Frame Technology
- CECC00802 Reflow (280°C)
- Single Isolated Output
- 1kVDC Isolation
- SOIC Package Style
- Efficiency to 75%
- Power Density 1.68W/cm^3
- 5V & 12V Input
- 5V, 9V, 12V and 15V Output
- Footprint from 0.98 cm^2
- UL94-V0 Package
- No Heatsink Required
- SMD Construction
- Toroidal Magnetics
- Plastic Encapsulated
- MTTF up to 2.6 Million hours
- PCB Mounting
- Custom Solutions Available



pin connections



description

The NMETM series of miniature surface-mounted DC-DC Converters employ lead-frame technology and transfer-moulding techniques to bring all of the benefits of IC style packaging to hybrid circuitry. The devices are fully compatible with CECC00802 to 280°C which allows them to be placed and reflowed with IC's, thus reducing time and cost in production. The co-planiarity of the pin positions is based apon IEC 191-6:1990. The devices are suitable for all applications where high volume production is envisaged.

absolute maximum ratings over operating free air* temperature range

Input voltage V_{IN} NME05 types	7V
Input voltage V_{IN} NME12 types	15V
Output power total	1W
Short-circuit duration	1s
Isolation voltage (flash tested for 1 second)	1000VDC
Operating free air temperature range	0°C to 70°C[1]
Storage temperature range	–55°C to 150°C
Lead temperature 1.5mm from case for 10 seconds	300°C
Peak reflow temperature with CECC 00802 profile	280°C

electrical specifications

(measured at T_A=25°C, at nominal input voltage)

Input voltage range NME05 types	5V±10%
Input voltage range NME12 types	12V±10%
Load voltage regulation (10% to 100% full load)	
5V output types	12% typical 14% max.
9V, 12V and 15V output types	8.5% max.
Line voltage regulation (10% to 100% full load)	1.2%/1% of V_{IN} max.
Output voltage accuracy	See tolerance envelope graph
Input reflected ripple (20MHz Band limited)	120mV p-p max.
Output ripple as a percentage of V_{OUT}	
5V output types	2.1% max.
9V output types	1.6% max.
12V output types	1.5% max.
15V output types	1.3% max.
Insulation resistance at 500VDC	1000 MΩ min.
Efficiency at full load, 5V output types	70% typical 65% min.
Efficiency at full load, 9V, 12V and 15V output types	75% typical 70% min.
Temperature drift (V_{OUT})	0.03% per °C max.
Temperature rise above ambient at full load	25°C max.
Weight (typical)	1.3 grams
Switching frequency at full load (typical)	125kHz
No load power consumption (typical)	140mW

* Free air – requires a minimum of 10mm air space around the component. [1] See derating curve.

selection guide

5V and 12V input types

Part Number	Output Voltage (V)	Output Current (mA)	Package Style
NMEXX05TM	5	200	1
NMEXX09TM	9	110	
NMEXX12TM	12	84	
NMEXX15TM	15	67	

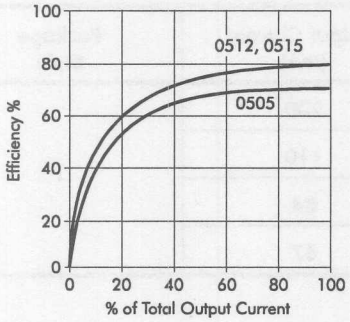
typical isolation capacitance (pF)

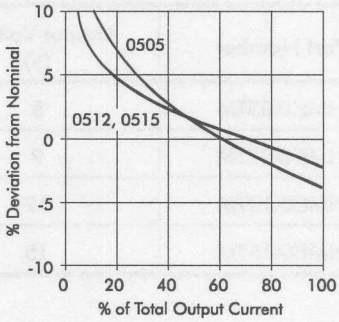
Part Number	Output Voltage (V)			
	05	09	12	15
NME05XXTM	24	32	26	32
NME12XXTM	33	51	59	61

Note : All data taken at T_A=25°C.

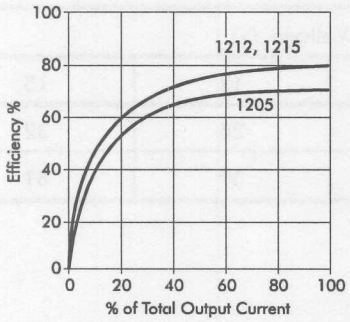
typical characteristics

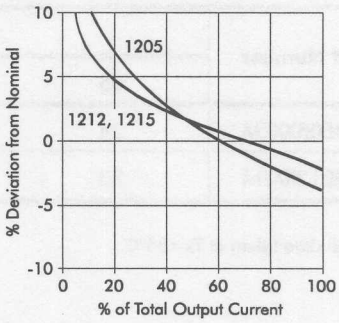
NME05 series



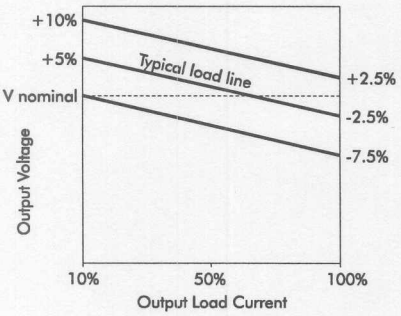


NME12 series

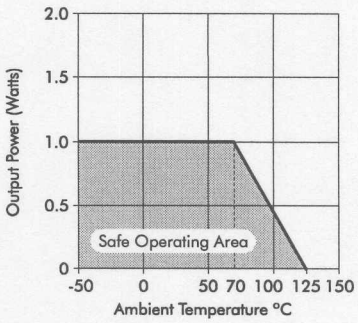




tolerance envelope



temperature derating graph



Note : All data taken at T_A=25°C.

See application notes on page 2-114

mean time to failure (MTTF) in thousands of hours

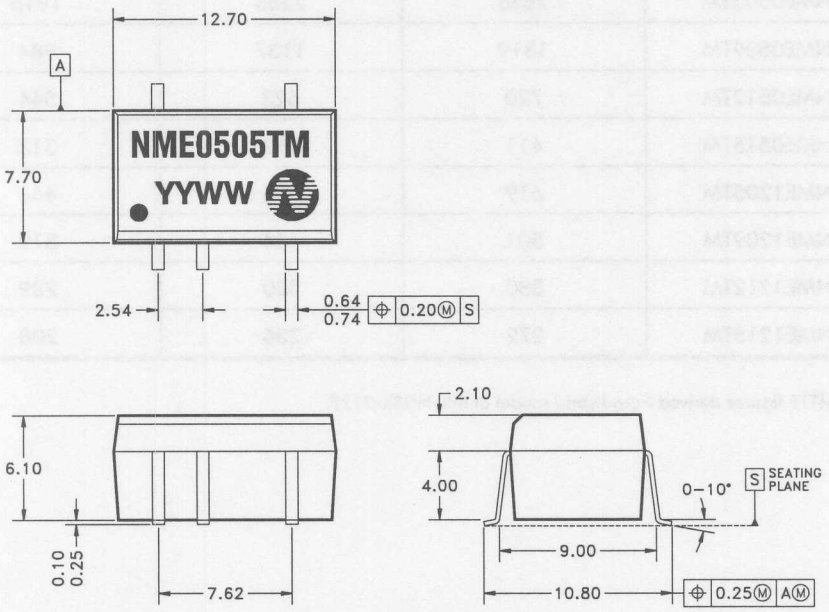
Part Number	–25°C	25°C	70°C
NME0505TM	2656	2265	1915
NME0509TM	1319	1137	984
NME0512TM	720	623	544
NME0515TM	411	357	313
NME1205TM	619	535	466
NME1209TM	501	434	379
NME1212TM	380	330	289
NME1215TM	272	236	208

Note : MTTF figures derived from hybrid model of MIL-HDBK-217F.

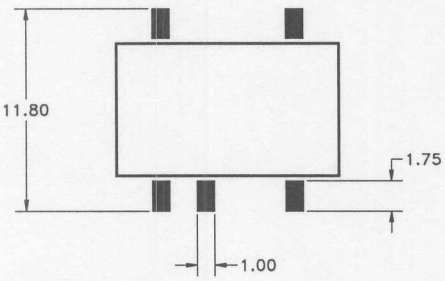
outline dimensions

14 Pin SMD package style

1



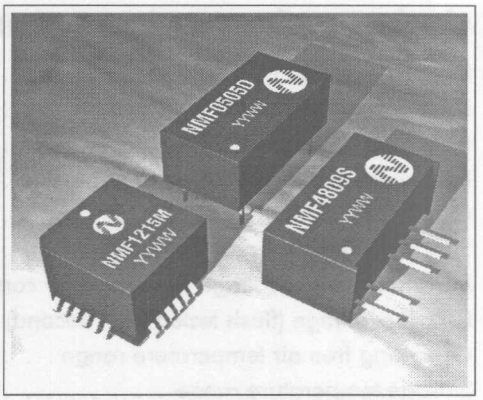
recommended footprint details



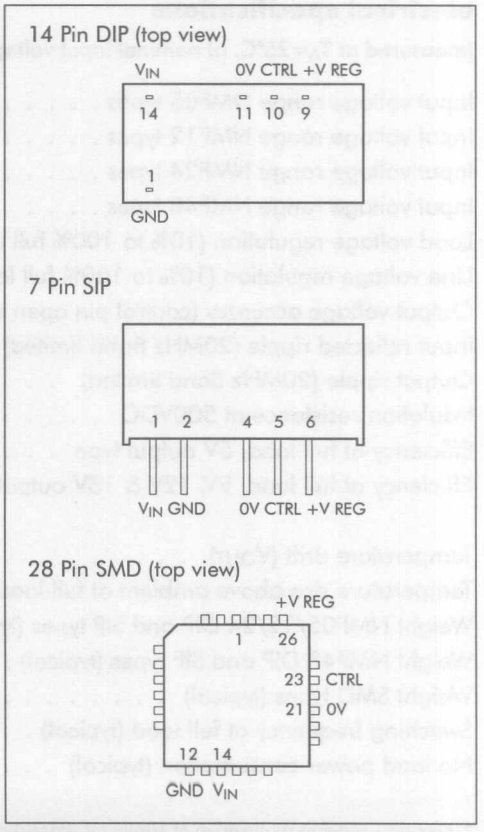
All pins on a 1.27mm pitch.
All dimensions in mm XX.XX ±0.25

features

- Output Regulation <1.5%
- Controllable Output
- 1kVDC Isolation
- Single Isolated Output
- Short Circuit Protected
- SIP, DIP & SMD Package Styles
- Efficiency to 62%
- Power Density 0.85W/cm^3
- 5V, 12V, 24V & 48V Input
- 5V, 9V, 12V, 12.75V & 15V Output
- Footprint from 1.17cm^2
- UL94-V0 Package
- No Heatsink Required
- SMD Construction
- Toroidal Magnetics
- Fully Encapsulated
- No External Components
- MTTF up to 2.4 Million hours
- PCB Mounting
- Custom Solutions Available



pin connections



description

The NMF series of DC-DC Converters is used where a tightly regulated supply is required. They are ideal for situations where the input voltage is not tightly controlled. The output control pin makes the device particularly suitable for Flash PROM applications where an on/off controlled voltage source is required.

absolute maximum ratings over operating free air* temperature range

Input voltage V_{IN} NMF05 types	7V
Input voltage V_{IN} NMF12 types	15V
Input voltage V_{IN} NMF24 types	28V
Input voltage V_{IN} NMF48 types	54V
Output power total	1W
Short-circuit duration	Indefinite
Maximum output voltage rise time after control pin high	35μs
Isolation voltage (flash tested for 1 second)	1000VDC
Operating free air temperature range	0°C to 70°C[1]
Storage temperature range	–55°C to 150°C
Lead temperature 1.5mm from case for 10 seconds	300°C

electrical specifications

(measured at T_A=25°C, at nominal input voltage)

Input voltage range NMF05 types	5V±5%
Input voltage range NMF12 types	12V±5%
Input voltage range NMF24 types	24V±5%
Input voltage range NMF48 types	48V±5%
Load voltage regulation (10% to 100% full load)	0.9% typical 1.5% max.
Line voltage regulation (10% to 100% full load)	0.25%/1% V_{IN}
Output voltage accuracy (control pin open circuit)	±5%
Input reflected ripple (20MHz Band limited)	40mV p-p max.
Output ripple (20MHz Band limited)	60mV p-p max.
Insulation resistance at 500VDC	100MΩ min.
Efficiency at full load, 5V output type	50% typical 45% min.
Efficiency at full load, 9V, 12V & 15V output types	62% typical 55% min.
Temperature drift (V_{OUT})	0.03% per °C max.
Temperature rise above ambient at full load	8°C
Weight NMF05/12/24 DIP and SIP types (typical)	2.3 grams
Weight NMF48 DIP and SIP types (typical)	2.9 grams
Weight SMD types (typical)	1.4 grams
Switching frequency at full load (typical)	80kHz
No load power consumption (typical)	100mW

* Free air – requires a minimum of 10mm air space around the component. [1] See derating curve.

selection guide

5V and 12V input types

Part Number	Output Voltage (V)	Output Current (mA)	Power Out (mW)	Package Style
NMFXX05D	5	100	500	1
NMFXX09D	9	100	900	
NMFXX12D	12	83	1000	
NMFXX15D	15	67	1000	
NMFXX05S	5	100	500	3
NMFXX09S	9	100	900	
NMFXX12S	12	83	1000	
NMFXX15S	15	67	1000	

surface mount 5V, 12V, 24V and 48V input types

Part Number	Output Voltage (V)	Output Current (mA)	Power Out (mW)	Package Style
NMFXX05M	5	100	500	5
NMFXX09M	9	100	900	
NMFXX12M	12	83	1000	
NMFXX15M	15	67	1000	

Flash PROM types

Part Number	Output Voltage (V)	Output Current (mA)	Power Out (mW)	Package Style
NMF0512D	12	83	1000	1
NMF0512S	12	83	1000	3
NMF0512M	12	83	1000	5
NMF0513D	12.75	78	1000	1
NMF0513S	12.75	78	1000	3
NMF0513M	12.75	78	1000	5

24V and 48V input types

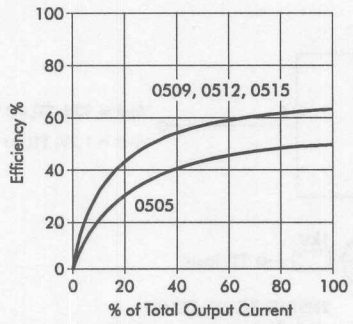
Part Number	Output Voltage (V)	Output Current (mA)	Power Out (mW)	Package Style
NMFXX05D	5	100	500	2
NMFXX09D	9	100	900	
NMFXX12D	12	83	1000	
NMFXX15D	15	67	1000	
NMFXX05S	5	100	500	4
NMFXX09S	9	100	900	
NMFXX12S	12	83	1000	
NMFXX15S	15	67	1000	

typical isolation capacitance (pF)

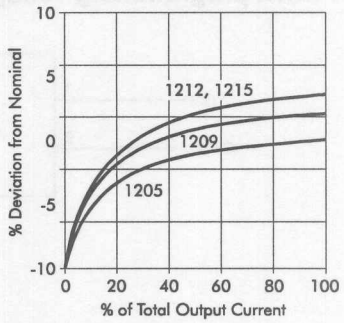
Part Number	Output Voltage (V)				
	05	09	12	13	15
NMF05XXX	28	32	33	31	39
NMF12XXX	48	63	68	-	69
NMF24XXX	84	106	132	-	152
NMF48XXX	54	75	92	-	109

typical characteristics

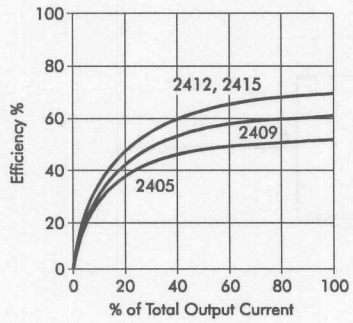
NMF05 series



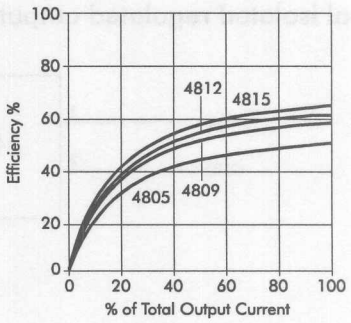
NMF12 series



NMF24 series



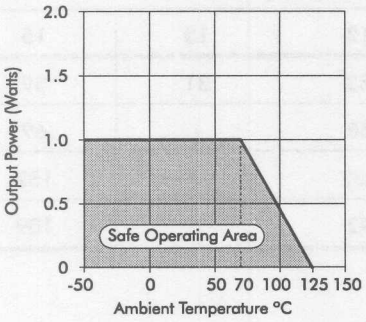
NMF48 series



Note : All data taken at T_A=25°C.

typical characteristics

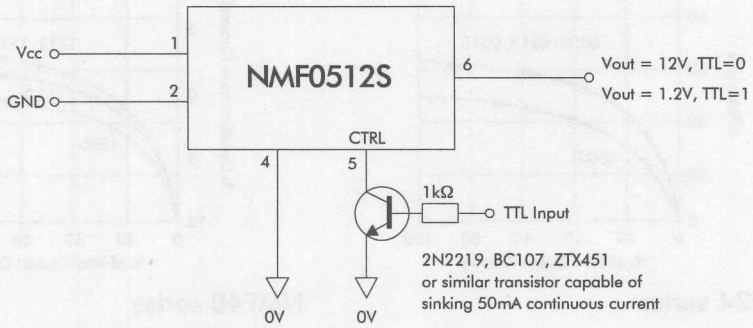
temperature derating graph



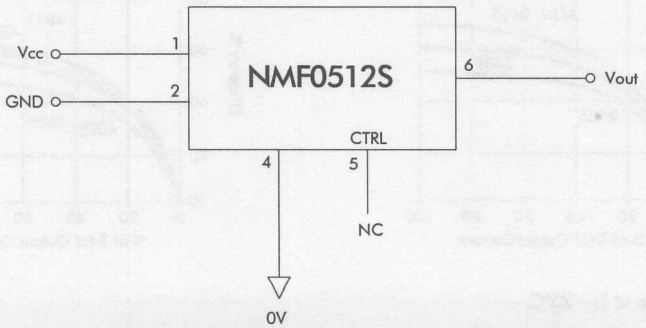
See application notes on page 2-114

typical applications

Flash PROM programming voltage control



normal isolated regulated output



mean time to failure (MTTF) in thousands of hours

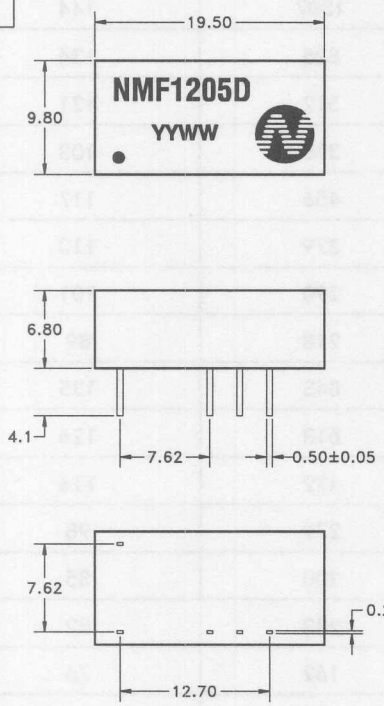
Part Number	–25°C	25°C	70°C
NMF0505	2406	1307	144
NMF0509	1243	825	134
NMF0512/13	691	512	121
NMF0515	399	316	103
NMF1205	604	456	117
NMF1209	489	379	110
NMF1212	372	290	101
NMF1215	267	218	89
NMF2405	1281	843	135
NMF2409	856	613	126
NMF2412	552	422	114
NMF2415	348	279	98
NMF4805	244	200	85
NMF4809	223	283	82
NMF4812	195	162	76
NMF4815	165	135	69

Note : MTTF figures derived from hybrid model of MIL-HDBK-217F.

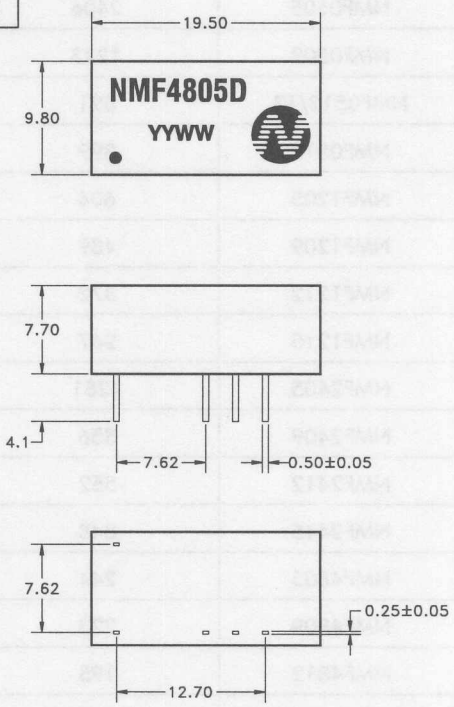
outline dimensions

14 Pin DIP package styles

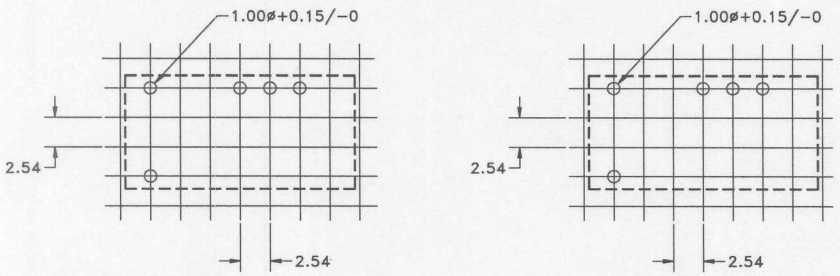
1



2



recommended footprint details



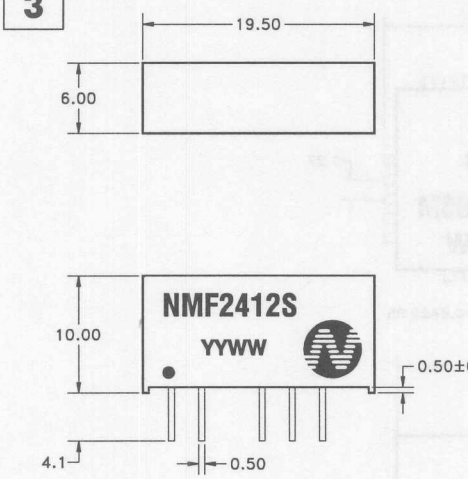
All pins on a 2.54mm pitch.

All dimensions in mm XX.X ±0.50, XX.XX ±0.25

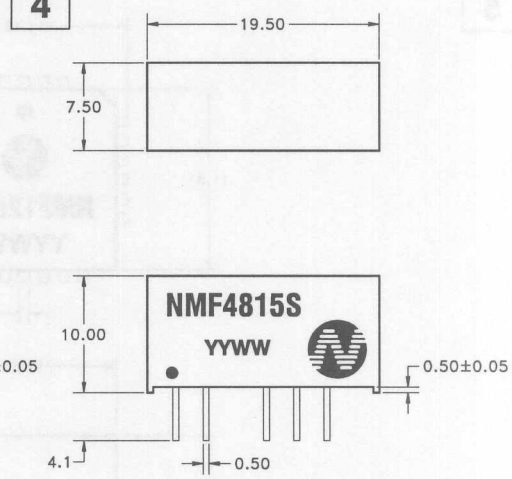
outline dimensions

7 Pin SIP package styles

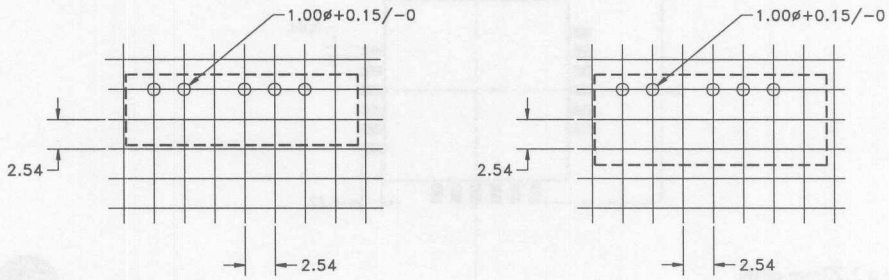
3



4



recommended footprint details



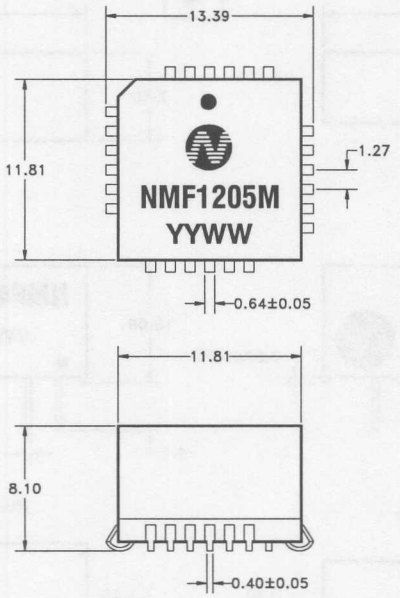
All pins on a 2.54mm pitch.

All dimensions in mm XX.X ±0.50, XX.XX ±0.25

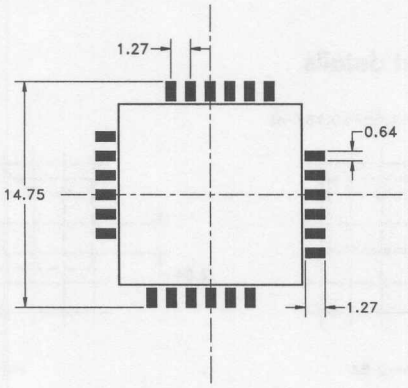
outline dimensions

28 Pin SMD package styles

5



recommended footprint details



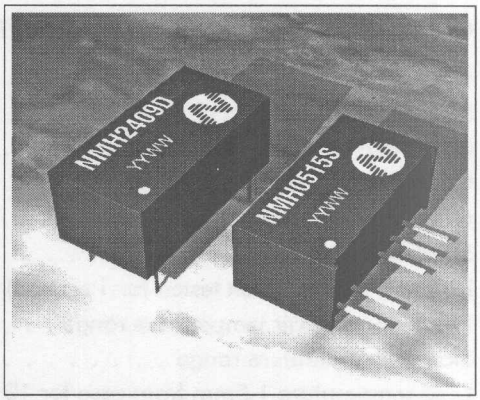
All pins on a 1.27mm pitch.
All dimensions in mm XX.XX ±0.25

features

- Full 2 Watt Output Power
- Pin Compatible with NMA
- 1kVDC Isolation
- Dual Outputs
- SIP & DIP package Styles
- Efficiency to 80%
- Power Density 1.42W/cm^3
- 5V, 12V,15V, 24V & 48V Input
- 5V, 9V, 12V, and 15V Output
- Footprint from 1.46 cm^2
- UL94-V0 Package
- No Heatsink Required
- Internal SMD Construction
- Toroidal Magnetics
- Fully Encapsulated
- No External Components Required
- MTTF up to 1.8 Million hours
- PCB Mounting
- Custom Solutions Available

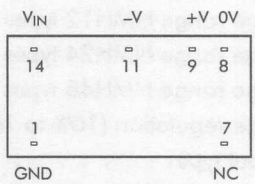
description

The NMH Series of DC-DC Converters offer the smallest footprint of any dual-output 2 Watt DC-DC Converter. Pin compatibility with the NMA series ensures minimal effort in upgrading distributed power systems. The devices are suited to any application where a dual rail supply is required in a minimum of pcb space.

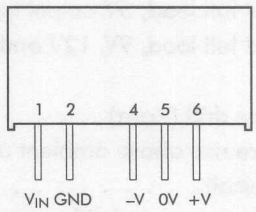


pin connections

14 Pin DIP (top view)



7 Pin SIP



absolute maximum ratings over operating free air* temperature range

Input voltage V_{IN} NMH05 types	7V
Input voltage V_{IN} NMH12 types	15V
Input voltage V_{IN} NMH24 types	28V
Input voltage V_{IN} NMH48 types	54V
Output power total	2W
Short-circuit duration	1s
Isolation voltage (flash tested for 1 second)	1000VDC
Operating free air temperature range	0°C to 70°C[1]
Storage temperature range	–55°C to 150°C
Lead temperature 1.5mm from case for 10 seconds	300°C

electrical specifications

(measured at T_A=25°C, at nominal input voltage)

Input voltage range NMH05 types	5V±10%
Input voltage range NMH12 types	12V±10%
Input voltage range NMH24 types	24V±10%
Input voltage range NMH48 types	48V±10%
Load voltage regulation (10% to 100% full load)	
5V output types	15% max.
9V, 12V and 15V output types	10% max.
Line voltage regulation (10% to 100% full load)	1.2%/1% of V_{IN}
Output voltage accuracy	See tolerance envelope graph
Input reflected ripple (20MHz Band limited)	100mV p-p max.
Output ripple (20MHz Band limited)	150mV p-p max.
Insulation resistance at 500VDC	1000MΩ min.
Efficiency at full load, 5V output type	65% min.
Efficiency at full load, 9V, 12V and 15V output type	70% min.
Temperature drift (V_{OUT})	0.01% per °C max.
Temperature rise above ambient at full load	25°C max.
Weight (typical)	2.35 grams
Switching frequency at full load (typical)	75kHz
No load power consumption (typical)	180mW

* Free air – requires a minimum of 10mm air space around the component. [1] See derating curve.

selection guide

5V, 12V, 24V and 48V input types

Part Number	Output Voltage (V)	Output Current Each Output (mA)	Package Style
NMHXX05D	±5	200	1
NMHXX09D	±9	111	
NMHXX12D	±12	83	
NMHXX15D	±15	67	
NMHXX05S	±5	200	2
NMHXX09S	±9	111	
NMHXX12S	±12	83	
NMHXX15S	±15	67	

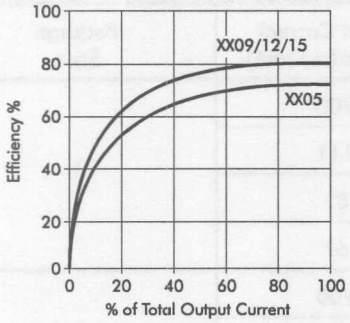
typical isolation capacitance (pF)

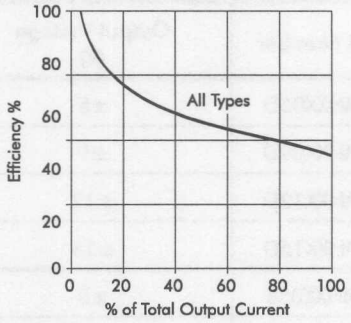
Part Number	Output Voltage (V)			
	05	09	12	15
NMH05XXX	29	37	41	44
NMH12XXX	43	57	73	81
NMH24XXX	42	64	81	98
NMH48XXX	40	60	79	94

Note : All data taken at T_A=25°C.

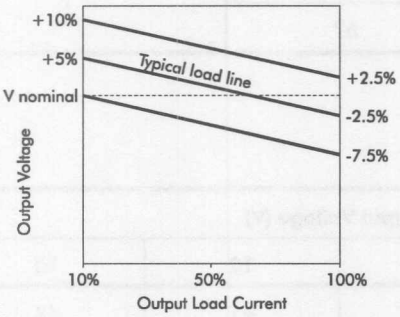
typical characteristics

NMH05, 12, 24 and 48 series

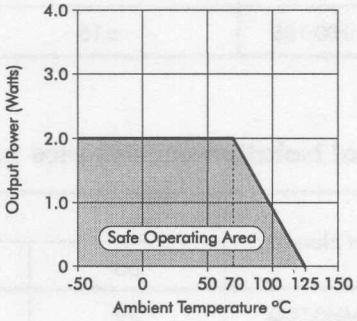




tolerance envelope

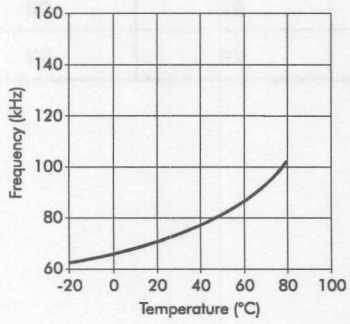


temperature derating graph



See application notes on page 2-114

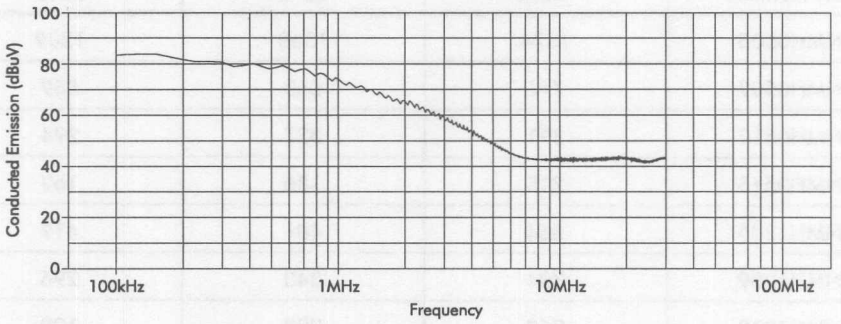
temperature test (under full load)



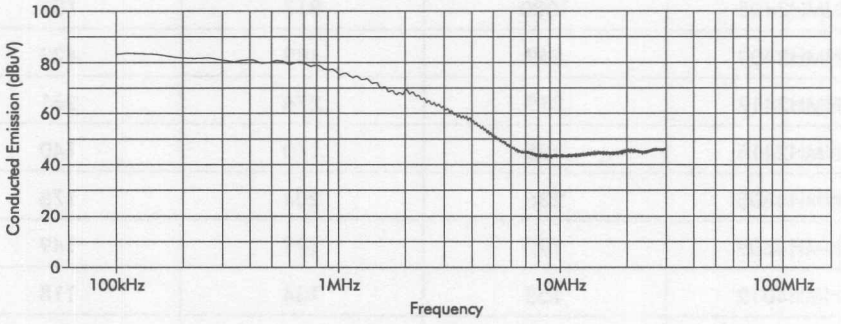
Note : All data taken at T_A=25°C.

typical characteristics

NMH05 series spectrum analysis (RBW=100kHz)



NMH12 series spectrum analysis (RBW=100kHz)



Note : All data taken at T_A=25°C.

mean time to failure (MTTF) in thousands of hours

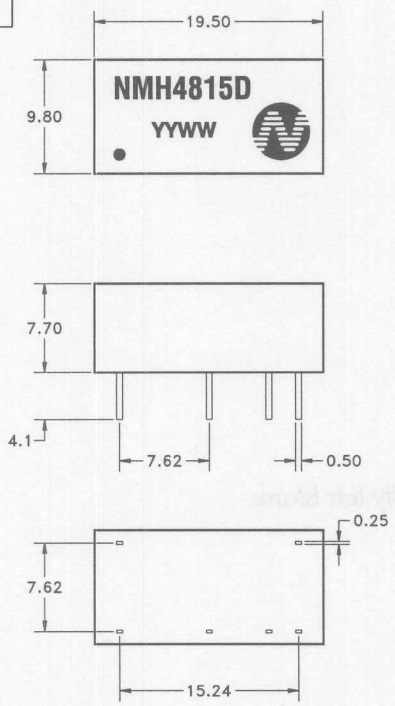
Part Number	–25°C	25°C	70°C
NMH0505	1874	1568	1309
NMH0509	771	660	569
NMH0512	391	337	294
NMH0515	215	186	162
NMH1205	564	484	419
NMH1209	394	340	296
NMH1212	263	228	199
NMH1215	170	147	128
NMH2405	1080	917	782
NMH2409	569	489	423
NMH2412	319	276	241
NMH2415	185	160	140
NMH4805	236	204	178
NMH4809	197	171	149
NMH4812	155	134	118
NMH4815	115	99	87

Note : MTTF figures derived from hybrid model of MIL-HDBK-217F.

outline dimensions

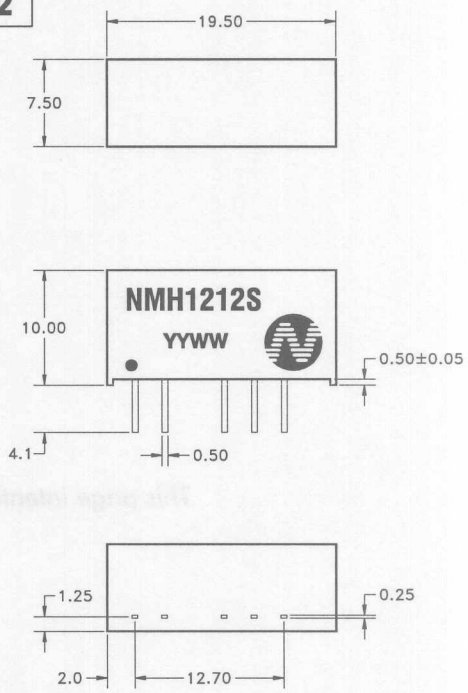
14 Pin DIP package style

1

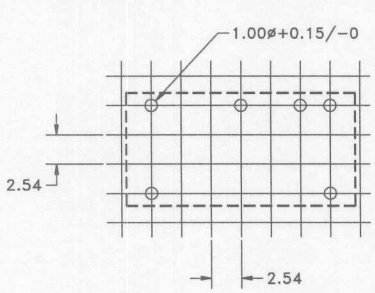


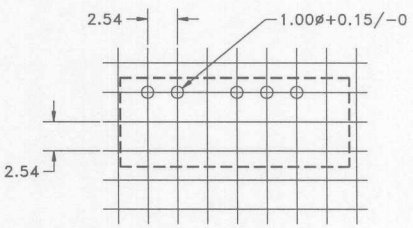
7 Pin SIP package style

2



recommended footprint details





All pins on a 2.54mm pitch.

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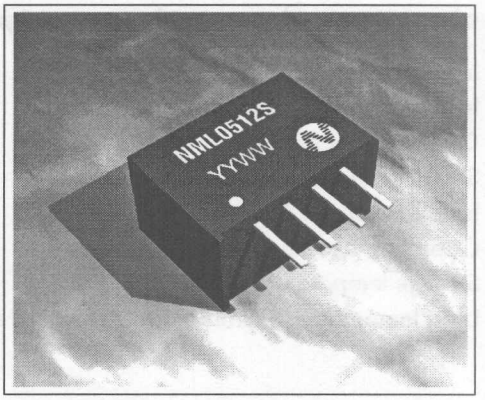
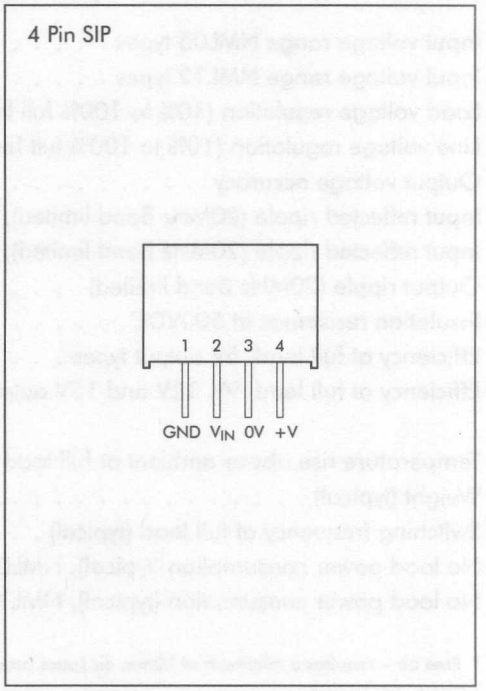
features

- Full 2 Watt Output Power
- 1kVDC Isolation
- Single Isolated Output
- Pin Compatible with LME and NME
- SIP Package Style
- Efficiency to 85%
- Power Density 2.01W/cm^3
- 5V & 12V Input
- 5V, 9V, 12V and 15V Output
- Footprint 1.05 cm^2
- UL94-V0 Package
- No Heatsink Required
- Internal SMD Construction
- Toroidal Magnetics
- Fully Encapsulated
- No External Components Required
- MTTF up to 2.5 Million Hours
- PCB Mounting
- Custom Solutions Available



pin connections



description

The NML is the smallest footprint 2 Watt DC-DC Converter currently available. Pin compatibility with the LME and NME ensures ease of upgradeability. The devices may be used wherever an isolated supply is required. The devices provide the isolation for 10 BASE 2 Ethernet applications and are particularly suited to Notebook Computer applications

PRELIMINARY
Notice : This is not a final specification.
Some parametric limits may be subject to change.

absolute maximum ratings over operating free air* temperature range

Input voltage V_{IN} NML05 types	7V
Input voltage V_{IN} NML12 types	15V
Output power total	2W
Short circuit duration	1s
Isolation voltage (flash tested for 1 second)	1000VDC
Operating free air temperature range	0°C to 70°C[1]
Storage temperature range	–55°C to 150°C
Lead temperature 1.5mm from case for 10 seconds	300°C

electrical specifications

(measured at T_A=25°C, at nominal input voltage)

Input voltage range NML05 types	5V±10%
Input voltage range NML12 types	12V±10%
Load voltage regulation (10% to 100% full load)	10% max.
Line voltage regulation (10% to 100% full load)	1.2%/1% of V_{IN}
Output voltage accuracy	See tolerance envelope graph
Input reflected ripple (20MHz Band limited), NML05 types	150mV p-p max.
Input reflected ripple (20MHz Band limited), NML12 types	300mV p-p max.
Output ripple (20MHz Band limited)	200mV p-p max.
Insulation resistance at 500VDC	1000 MΩ min.
Efficiency at full load, 5V output types	80% typical 70% min.
Efficiency at full load, 9V, 12V and 15V output types	85% typical 75% min.
Temperature rise above ambient at full load	30°C max.
Weight (typical)	2.0 grams
Switching frequency at full load (typical)	75kHz
No load power consumption (typical), NML05 types	200mW
No load power consumption (typical), NML12 types	250mW

* Free air – requires a minimum of 10mm air space around the component.

[1] See derating curve.

selection guide

5V and 12V input types

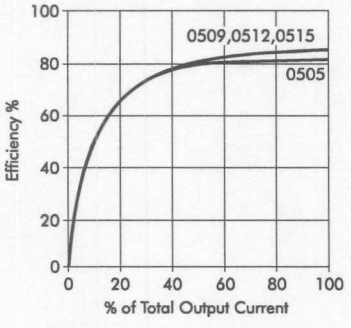
Part Number	Output Voltage (V)	Output Current (mA)	Package Style
NMLXX05S	5	400	1
NMLXX09S	9	222	
NMLXX12S	12	167	
NMLXX15S	15	133	

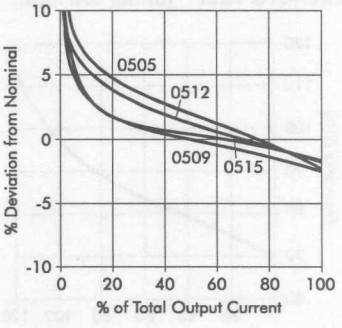
typical isolation capacitance (pF)

Part Number	Output Voltage (V)			
	05	09	12	15
NML05XXS	28	34	36	38
NML12XXS	37	59	65	72

typical characteristics

NML05 series

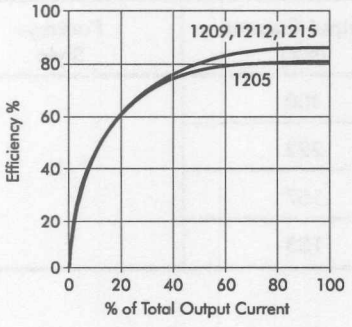


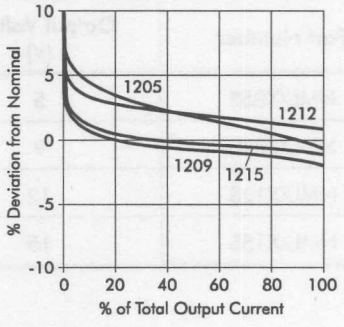


Note : All data taken at T_A=25°C.

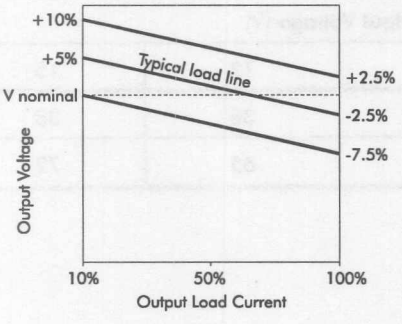
typical characteristics

NML12 series

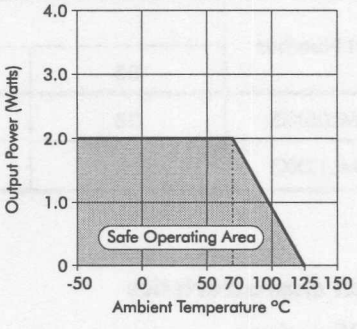




tolerance envelope

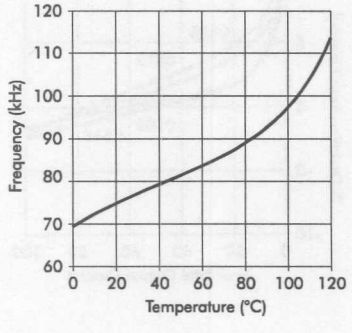


temperature derating graph



See application notes on page 2-114

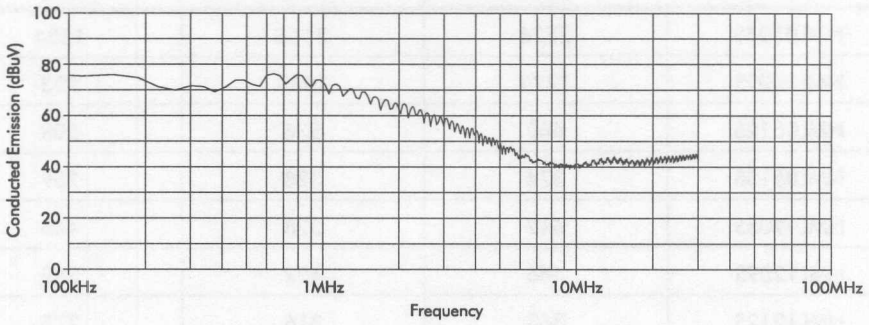
temperature test (under full load)



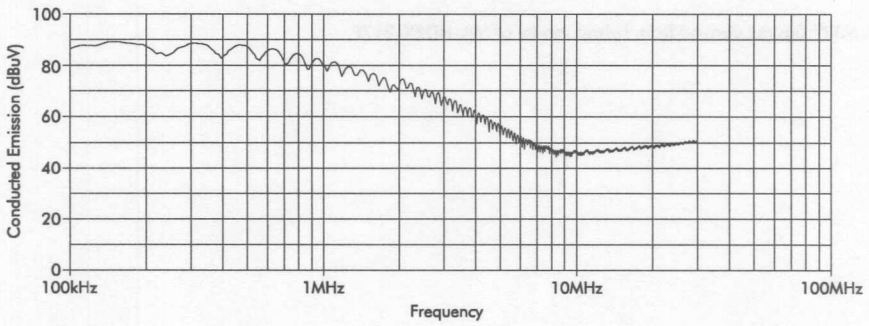
Note : All data taken at T_A=25°C.

typical characteristics

NML05 series spectrum analysis (RBW=100kHz)



NML12 series spectrum analysis (RBW=100kHz)



Note : All data taken at T_A=25°C.

mean time to failure (MTTF) in thousands of hours

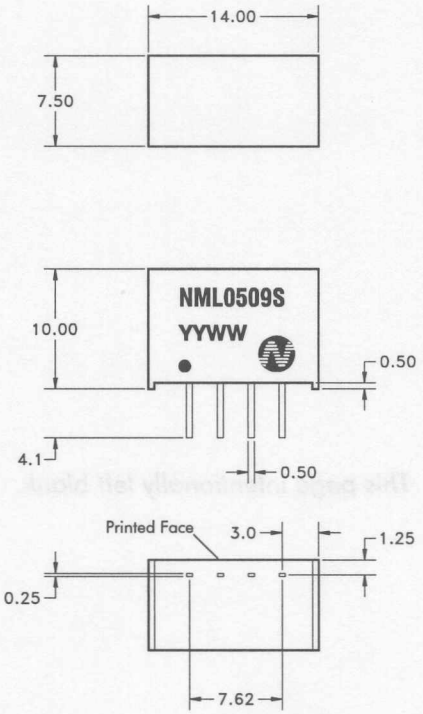
Part Number	–25°C	25°C	70°C
NML0505S	2526	2146	1824
NML0509S	1223	1060	923
NML0512S	660	576	508
NML0515S	374	328	289
NML1205S	612	528	460
NML1209S	486	422	369
NML1212S	363	316	278
NML1215S	256	223	197

Note : MTTF figures derived from hybrid model of MIL-HDBK-217F.

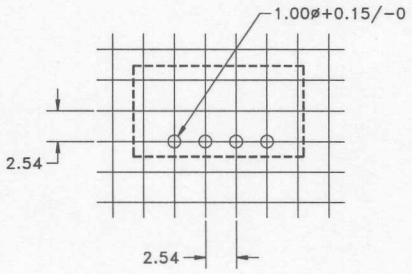
outline dimensions

4 Pin SIP package style

1



recommended footprint details



All pins on a 2.54mm pitch.

All dimensions in mm XX.X ±0.50, XX.XX ±0.25

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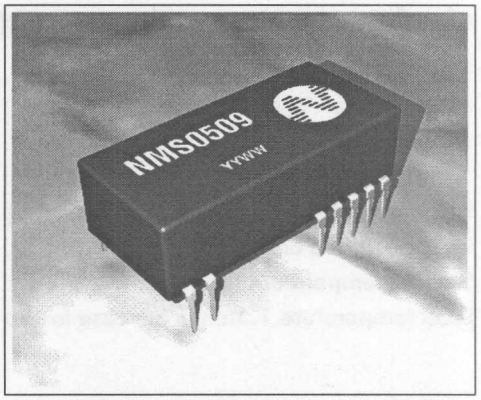
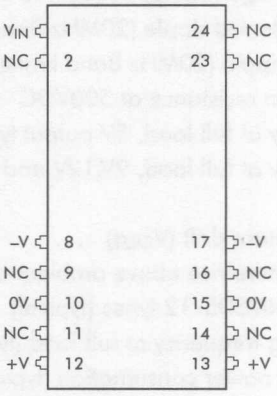
features

- BS EN 60950 Certified
- 6kVDC Isolation
- Dual Output
- Low Profile Package
- Efficiency to 80%
- Power Density 0.65W/cm^3
- 5V & 12V Input
- 5V, 9V, 12V and 15V Output
- Footprint 4.75 cm^2
- UL94-V0 Package
- No Heatsink Required
- Internal SMD Construction
- Toroidal Magnetics
- No External Components Required
- MTTF up to 1.0 Million Hours
- Custom Solutions Available



pin connections

24 Pin DIL (top view)



description

The NMS Series of DC-DC Converters are fully certified to BS EN 60950, this makes them ideal for all Telecom and safety applications where approved isolation is required. The low profile package allows mounting in rack systems without risk of touching other boards. The output configuration allows all of the rated power to be drawn from a single pin provided the total load does not exceed 2 Watts. The devices feature low noise and low isolation capacitance suitable for applications in high noise enviroments, eg heavy electrical machine interface.

BS EN 60950 CERTIFIED
Certified to meet BS EN 60950, BS EN 41003
Certificate number 7789 applies.

absolute maximum ratings over operating free air* temperature range

Input voltage V_{IN} NMS05 types	7V
Input voltage V_{IN} NMS12 types	15V
Output power total	2W
Short-circuit duration	1s
Isolation voltage (flash tested for 1 second)	6000VDC
Operating free air temperature range	0°C to 70°C
Storage temperature range	–55°C to 150°C
Lead temperature 1.5mm from case for 10 seconds	300°C

electrical specifications

(measured at T_A=25°C, at nominal input voltage)

Input voltage range NMS05 types	5V±10%
Input voltage range NMS12 types	12V±10%
Line voltage regulation (10% to 100% full load)	1.2%/1% of V_{IN}
Load voltage regulation (10% to 100% full load)	15% max.
Input reflected ripple (20MHz Band limited)	300mV p-p max.
Output ripple (20MHz Band limited)	150mV p-p max.
Insulation resistance at 500VDC	1000MΩ min.
Efficiency at full load, 5V output type	70% typical, 65% min.
Efficiency at full load, 9V,12V and 15V output types	75% typical, 70% min.
Temperature drift (V_{OUT})	0.2% per °C max.
Temperature rise above ambient at full load	20°C
Weight NMS05/12 types (typical)	6 grams
Switching frequency at full load (typical)	35kHz
No load power consumption (typical) NMS05 types	350mW
No load power consumption (typical) NMS12 types	250mW

* Free air - requires a minimum of 10mm air space around the component.

selection guide

5V and 12V input types

Part Number	Output Voltage (V)	Output Current Each Output (mA)	Package Style
NMSXX05	±5	200	1
NMSXX09	±9	111	
NMSXX12	±12	83	
NMSXX15	±15	67	

typical isolation capacitance (pF)

Part Number	Output Voltage (V)			
	05	09	12	15
NMS05XX	1.8	1.9	2.0	2.1
NMS12XX	1.9	2.0	2.1	2.2

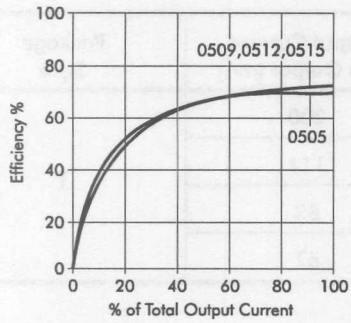
typical common mode rejection ratio (dB)

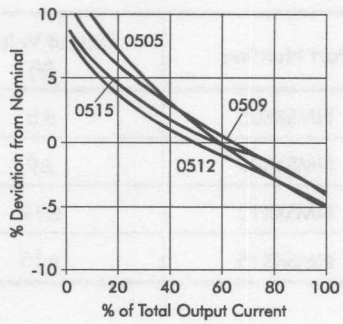
Part Number	Output Voltage (V)			
	05	09	12	15
NMS05XX	68.1	67.9	67.8	67.7
NMS12XX	67.9	67.3	67.1	66.8

Note : All data taken at T_A=25°C.

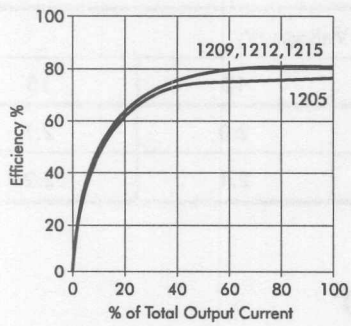
typical characteristics

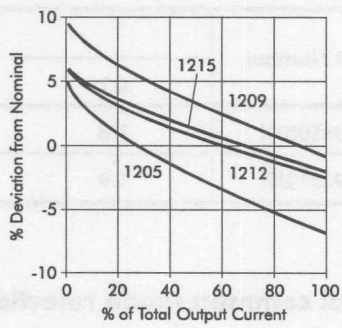
NMS05 series



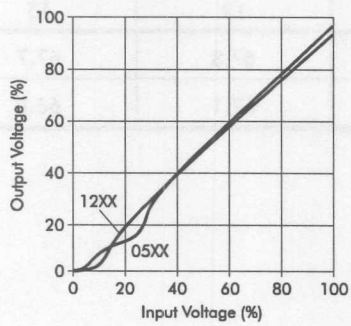


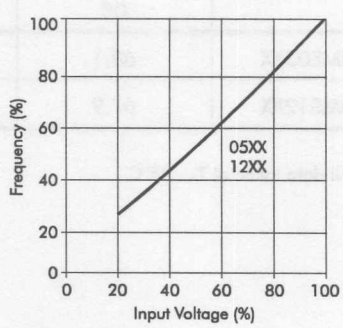
NMS12 series





voltage dependency

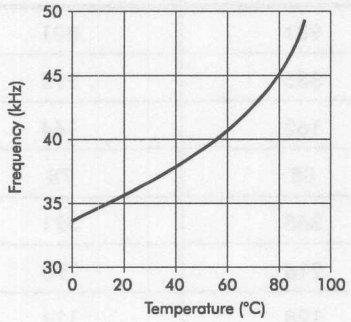




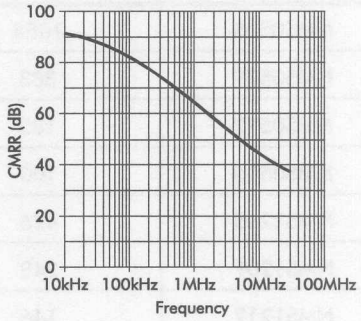
Note : All data taken at T_A=25°C.

typical characteristics

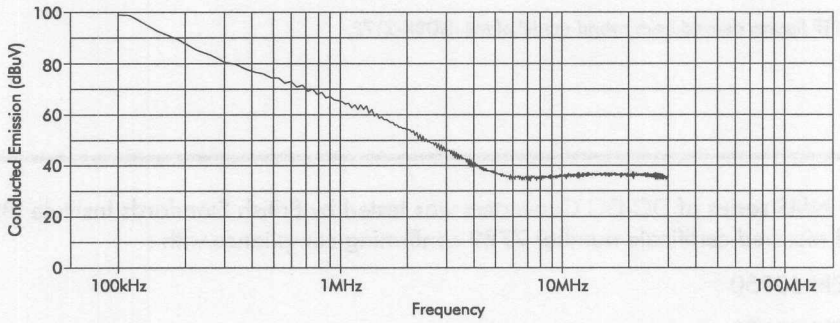
temperature test (under full load)



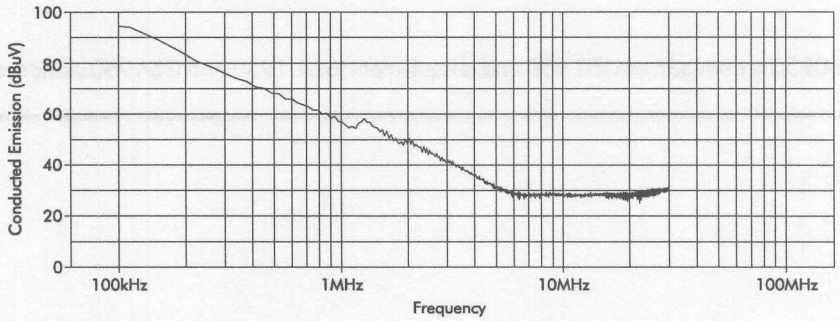
CMRR vs frequency



NMS05 series spectrum analysis (RBW=100kHz)



NMS12 series spectrum analysis (RBW=100kHz)



Note : All data taken at T_A=25°C.

mean time to failure (MTTF) in thousands of hours

Part Number	–25°C	25°C	70°C
NMS0505	1084	931	801
NMS0509	383	335	295
NMS0512	185	162	144
NMS0515	100	88	78
NMS1205	426	368	321
NMS1209	248	216	190
NMS1212	146	128	114
NMS1215	87	77	68

Note : MTTF figures derived from hybrid model of MIL-HDBK-217F.

The NMS series of DC-DC Converters was tested by British Standards Institute (BSI) and received certificate number 7789 confirming compliance with :

BS EN 60950

BS EN 41003

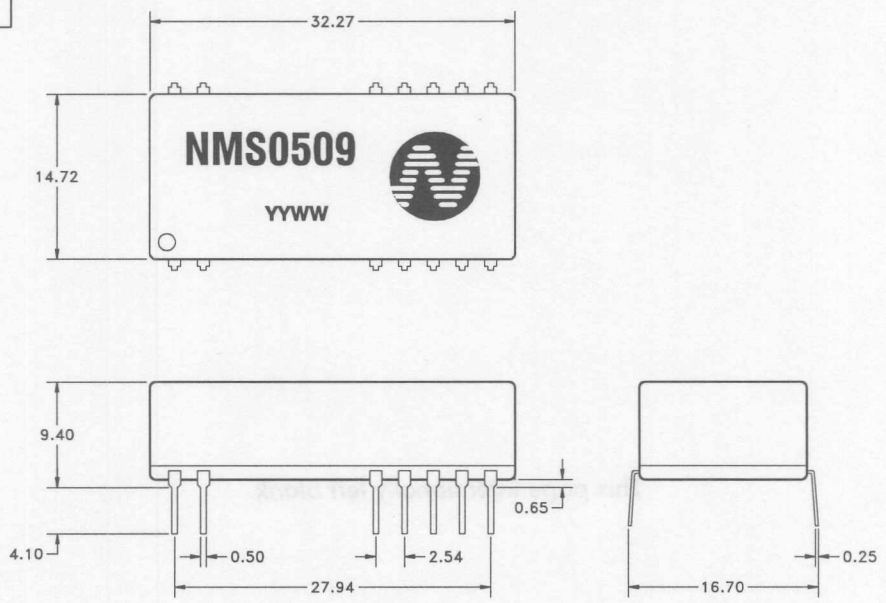
for supplementary insulation.

EN 60950 is derived from IEC 950 and is equivalent to UL 1950 and CSA 950 standards.

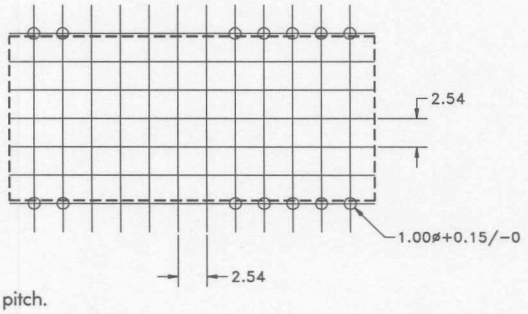
outline dimensions

24 Pin DIL package style

1



recommended footprint details



All pins on a 2.54mm pitch.
All dimensions in mm XX.XX ±0.25

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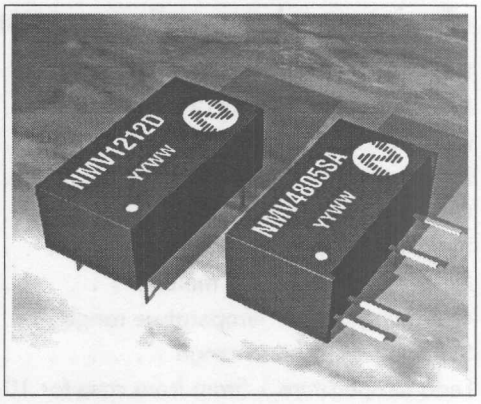
features

- 3kVDC Isolation (1 Minute)
- Single or Dual Outputs
- Power Sharing on Dual Version
- SIP & DIP Package Styles
- Efficiency to 80%
- Power Density 0.89W/cm^3
- 5V, 12V, 24V & 48V Input
- 5V, 9V, 12V and 15V Output
- Footprint from 1.17 cm^2
- UL94-V0 Package
- No Heatsink Required
- Internal SMD Construction
- Toroidal Magnetics
- Fully Encapsulated
- No External Components Required
- MTTF up to 2.6 Million Hours
- PCB Mounting
- Custom Solutions Available

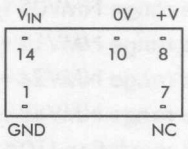
description

The NMV Series offers single or dual output versions in the same size package as the popular NMA series. The higher isolation is particularly useful in control type applications where the standard 1kV is not sufficient.

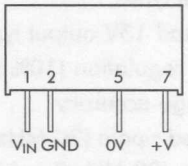


pin connections

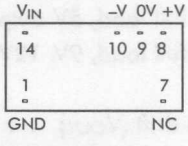
14 Pin DIP Single Output Type (top view)



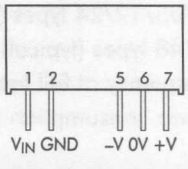
7 Pin SIP Single Output Type



14 Pin DIP Dual Output Type (top view)



7 Pin SIP Dual Output Type



absolute maximum ratings over operating free air* temperature range

Input voltage V_{IN} NMV05 types	7V
Input voltage V_{IN} NMV12 types	15V
Input voltage V_{IN} NMV24 types	28V
Input voltage V_{IN} NMV48 types	54V
Output power total	1W
Short-circuit duration	1s
Isolation voltage (for 1 minute)	3000VDC
Operating free air temperature range	0°C to 70°C[1]
Storage temperature range	–55°C to 150°C
Lead temperature 1.5mm from case for 10 seconds	300°C

electrical specifications

(measured at T_A=25°C, at nominal input voltage)

Input voltage range NMV05 types	5V±10%
Input voltage range NMV12 types	12V±10%
Input voltage range NMV24 types	24V±10%
Input voltage range NMV48 types	48V±10%
Load voltage regulation (10% to 100% full load)	
5V output types	15% max.
9V,12V and 15V output types	10% max.
Line voltage regulation (10% to 100% full load)	1.2%/1% of V_{IN}
Output voltage accuracy	See tolerance envelope graph
Input reflected ripple (20 MHz Band limited)	80mV p-p max.
Output ripple (20 MHz Band limited)	150mV p-p max.
Insulation resistance at 500VDC	1000MΩ min.
Efficiency at full load, 5V output type	70% typical 65% min.
Efficiency at full load, 9V, 12V and 15V output types	80% typical 70% min.
Temperature drift (V_{OUT})	0.03% per °C max.
Temperature rise above ambient at full load	8°C max.
Weight NMV05/12/24 types (typical)	2.3 grams
Weight NMV48 types (typical)	2.9 grams
Switching frequency at full load (typical)	100kHz
No load power consumption (typical)	100mW

* Free air – requires a minimum of 10mm air space around the component. [1] See derating curve.

selection guide

single output types - 5V, 12V, and 24V input types

Part Number	Output Voltage (V)	Output Current (mA)	Package Style
NMVXX05DA	5	200	1
NMVXX09DA	9	112	
NMVXX12DA	12	84	
NMVXX15DA	15	67	
NMVXX05SA	5	200	5
NMVXX09SA	9	112	
NMVXX12SA	12	84	
NMVXX15SA	15	67	

Note : Any part number ending with an A indicates it is a single output type,
e.g. NMV0505DA is a dual-in-line single output type.

dual output types - 5V, 12V and 24V input types

Part Number	Output Voltage (V)	Output Current Each Output (mA)	Package Style
NMVXX05D	±5	100	3
NMVXX09D	±9	56	
NMVXX12D	±12	42	
NMVXX15D	±15	34	
NMVXX05S	±5	100	7
NMVXX09S	±9	56	
NMVXX12S	±12	42	
NMVXX15S	±15	34	

selection guide

single output types - 48V input types

Part Number	Output Voltage (V)	Output Current (mA)	Package Style
NMV4805DA	5	200	2
NMV4809DA	9	112	
NMV4812DA	12	84	
NMV4815DA	15	67	
NMV4805SA	5	200	6
NMV4809SA	9	112	
NMV4812SA	12	84	
NMV4815SA	15	67	

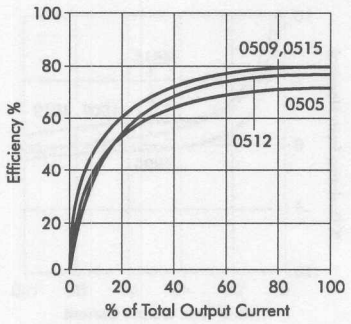
Note : Any part number ending with an A indicates it is a single output type,
e.g. NMV4805DA is a dual-in-line single output type.

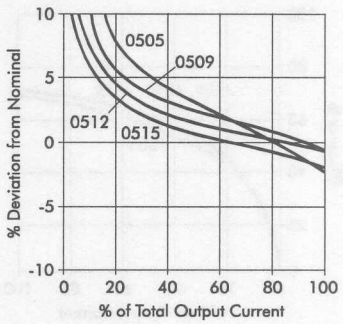
dual output types - 48V input types

Part Number	Output Voltage (V)	Output Current Each Output (mA)	Package Style
NMV4805D	±5	100	4
NMV4809D	±9	56	
NMV4812D	±12	42	
NMV4815D	±15	34	
NMV4805S	±5	100	8
NMV4809S	±9	56	
NMV4812S	±12	42	
NMV4815S	±15	34	

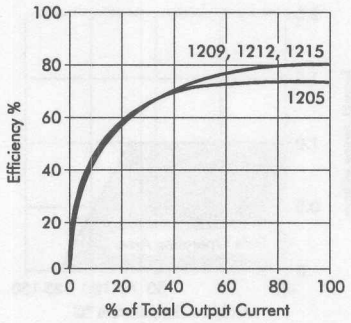
typical characteristics

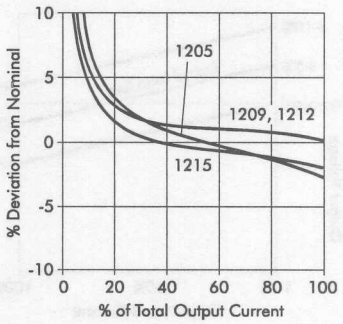
NMV05 series



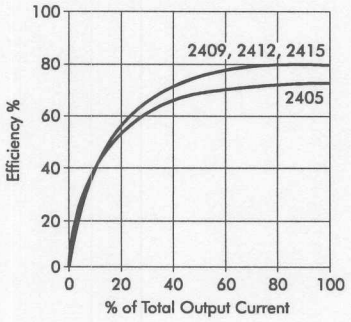


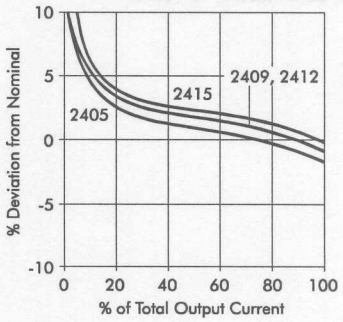
NMV12 series





NMV24 series

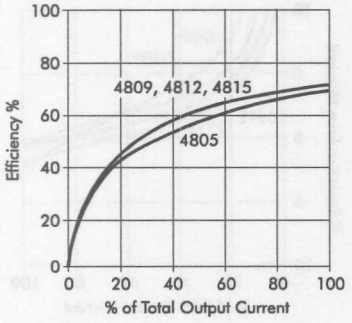


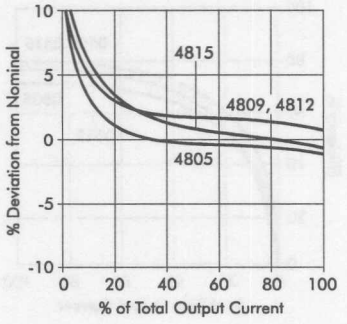


Note : All data taken at T_A=25°C.

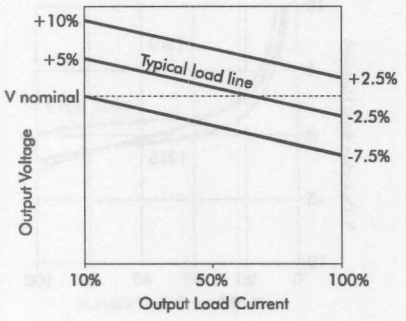
typical characteristics

NMV48 series

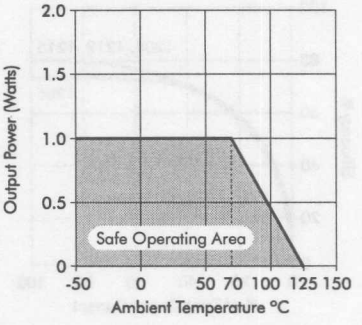




tolerance envelope



temperature derating graph



See application notes on page 2-114

Note : All data taken at T_A=25°C.

typical isolation capacitance (pF)

Part Number	Output Voltage (V)			
	05	09	12	15
NMV05XXD/S	21	21	26	25
NMV05XXDA/SA	23	25	29	30
NMV12XXD/S	31	40	55	61
NMV12XXDA/SA	23	25	29	30
NMV24XXD/S	45	52	65	70
NMV24XXDA/SA	33	40	55	70
NMV48XXD/S	45	58	68	75
NMV48XXDA/SA	48	59	70	81

Note : All data taken at T_A=25°C.

mean time to failure (MTTF) in thousands of hours

single output types ('A' Suffix)

Part Number	–25°C	25°C	70°C
NMV0505	2656	2265	1915
NMV0509	1319	1137	984
NMV0512	720	623	544
NMV0515	411	357	313
NMV1205	619	535	466
NMV1209	501	434	379
NMV1212	380	330	289
NMV1215	272	235	208
NMV2405	231	201	176
NMV2409	213	185	162
NMV2412	187	163	143
NMV2415	157	136	120
NMV4805	246	213	187
NMV4809	224	194	170
NMV4812	195	169	148
NMV4815	161	140	123

Note : MTTF figures derived from hybrid model of MIL-HDBK-217F.

mean time to failure (MTTF) in thousands of hours

dual output types (No 'A' Suffix)

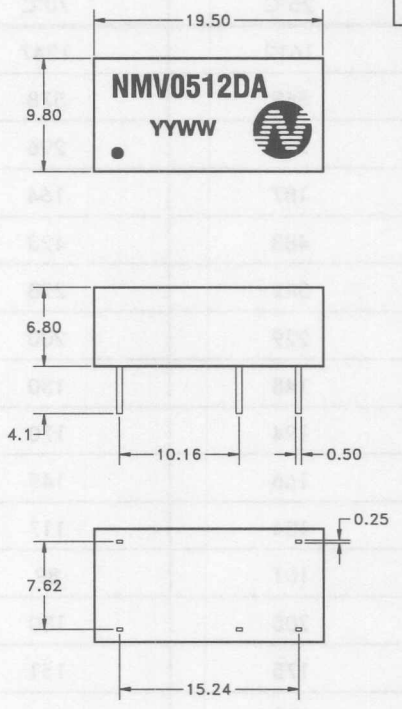
Part Number	–25°C	25°C	70°C
NMV0505	1899	1612	1347
NMV0509	775	669	578
NMV0512	392	339	296
NMV0515	216	187	164
NMV1205	566	488	423
NMV1209	395	342	298
NMV1212	264	229	200
NMV1215	170	148	130
NMV2405	224	194	170
NMV2409	191	166	145
NMV2412	154	134	117
NMV2415	117	101	89
NMV4805	237	205	180
NMV4809	199	175	151
NMV4812	158	137	120
NMV4815	117	102	90

Note : MTTF figures derived from hybrid model of MIL-HDBK-217F.

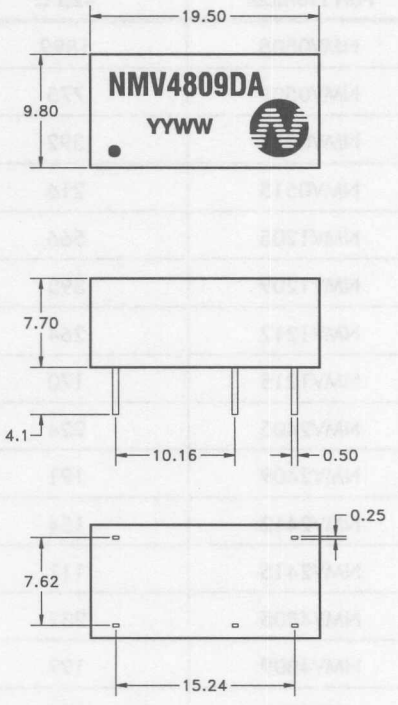
outline dimensions

single output 14 Pin DIP package styles

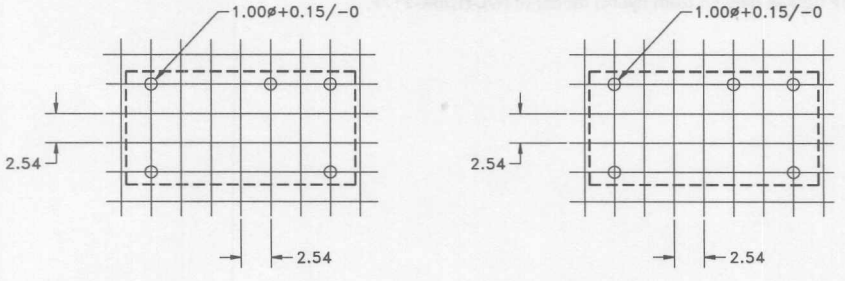
1



2



recommended footprint details



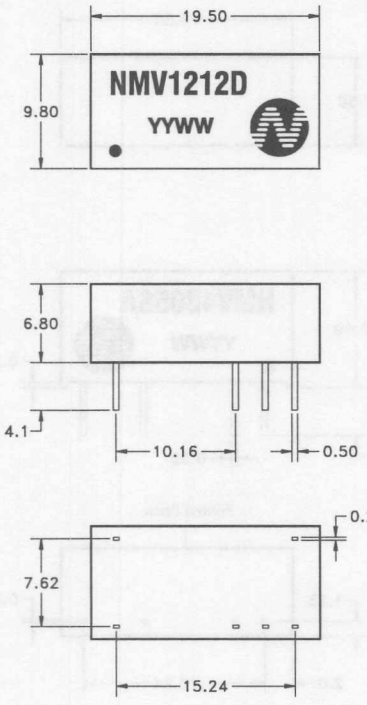
All pins on a 2.54mm pitch.

All dimensions in mm XX.X ±0.50, XX.XX ±0.25

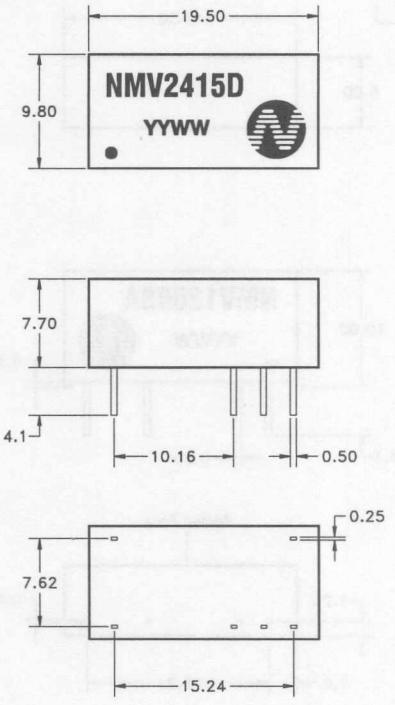
outline dimensions

dual output 14 Pin DIP package styles

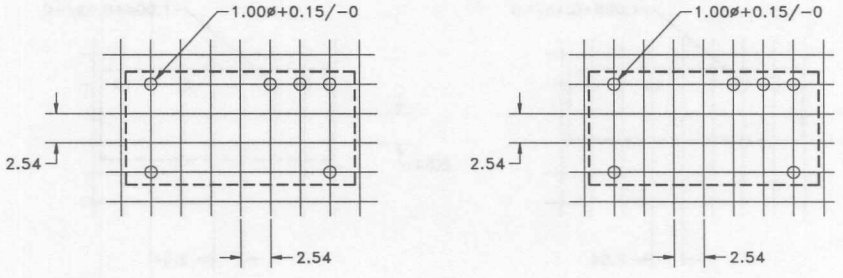
3



4



recommended footprint details

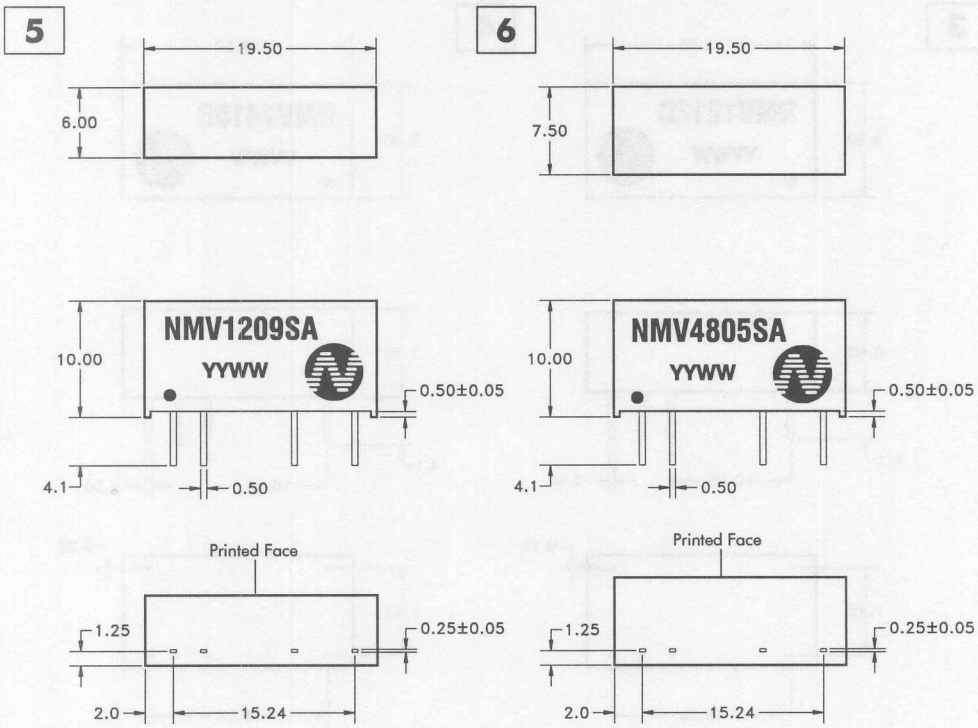


All pins on a 2.54mm pitch.

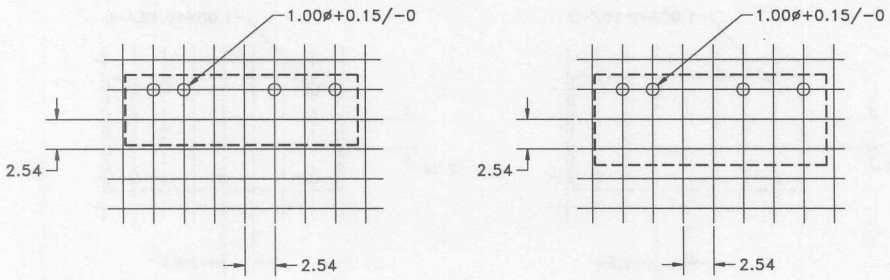
All dimensions in mm XX.X ±0.50, XX.XX ±0.25

outline dimensions

single output 7 Pin SIP package styles



recommended footprint details

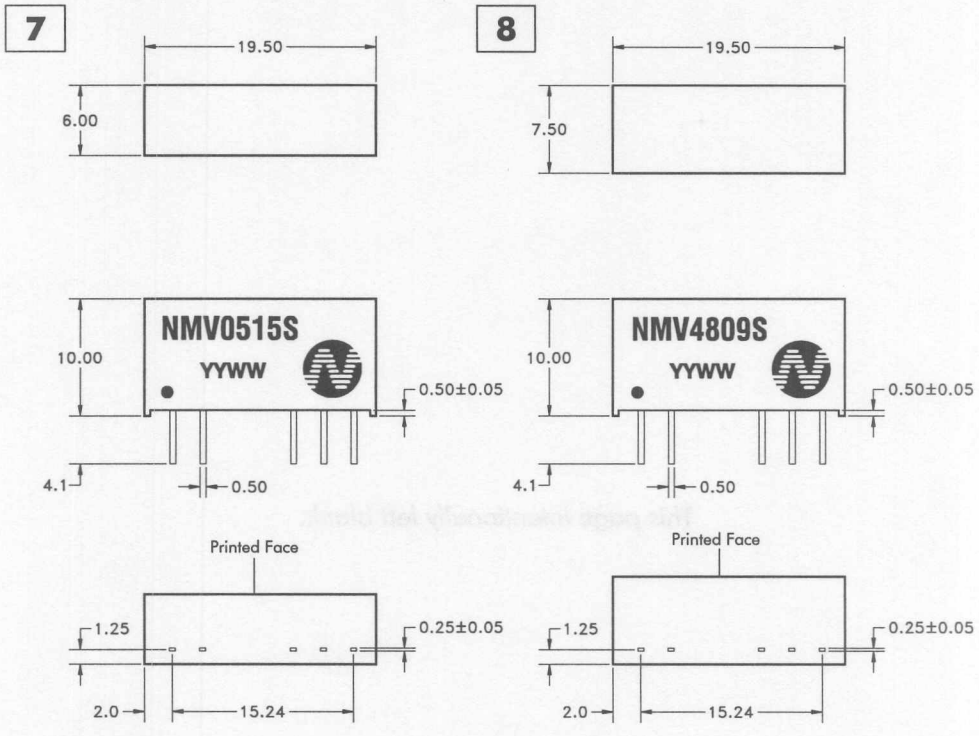


All pins on a 2.54mm pitch.

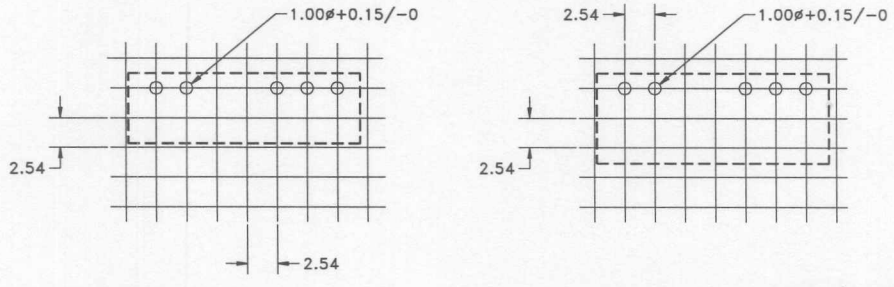
All dimensions in mm XX.X ±0.50, XX.XX ±0.25

outline dimensions

dual output 7 Pin SIP package styles



recommended footprint details



All pins on a 2.54mm pitch.

All dimensions in mm XX.X ±0.50, XX.XX ±0.25

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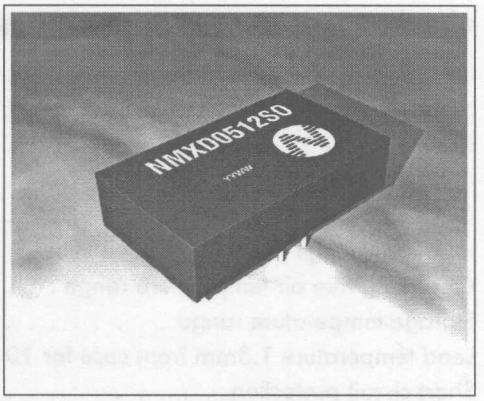
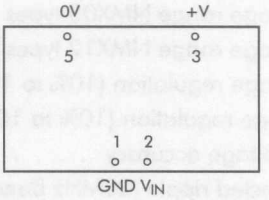
features

- Industry Standard Pinout
- Pin Compatible with NMXU
- Output Regulation 0.5%
- 1kVDC Isolation
- Single or Dual Output
- Short Circuit Protected
- Low Profile Package
- Efficiency to 75%
- Power Density 0.53W/cm^3
- 5V & 12V input
- 5V, 12V and 15V Output
- Footprint 9.52cm^2
- UL94-V0 Package
- No Heatsink Required
- Internal SMD Construction
- Toroidal Magnetics
- Fully Encapsulated
- MTTF up to 1.0 Million Hours
- Custom Solutions Available

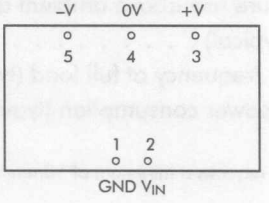


pin connections

Single Output Type (top view)



Dual Output Type (top view)



description

The NMXSO series offers a regulated 5W output in a low profile industry-standard package. When upgrading to the NMXSO from 2" square parts, it is possible to use the additional 16.28cm^2 to add additional circuitry or reduce the overall board size. The device is protected against short-term short circuits. The regulation is ideal for stabilising supply voltages which vary due to loading, eg on backplanes in distributed power systems.

absolute maximum ratings over operating free air* temperature range

Input voltage V_{IN} NMX05 types	7V
Input voltage V_{IN} NMX12 types	15V
Output power 5V output types	5W
Output power 12V output types	5.6W
Output power 15V output types	6W
Isolation voltage (flash tested for 1 second)	1000VDC
Operating free air temperature range	0°C to 70°C
Storage temperature range	–55°C to 100°C
Lead temperature 1.5mm from case for 10 seconds	300°C
Short circuit protection	15 seconds max.

electrical specifications

(measured at TA=25°C, at nominal input voltage)

Input voltage range NMX05 types	5V±10%
Input voltage range NMX12 types	12V±10%
Load voltage regulation (10% to 100% full load)	0.5%
Line voltage regulation (10% to 100% full load)	±0.5%
Output voltage accuracy	±3%
Input reflected ripple (20MHz Band Limited)	150mV p-p max.
Output ripple (20 MHz Band limited)	150mV p-p max.
Insulation resistance at 1000VDC	1000MΩ min.
Efficiency at full load	65% typical 55% min.
Temperature drift (V_{OUT})	0.015% per °C max.
Temperature rise above ambient at full load	30°C max.
Weight (typical)	20 grams
Switching frequency at full load (typical)	70kHz
No load power consumption (typical)	700mW

* Free air – requires a minimum of 10mm air space around the component.

selection guide

single output types - 5V and 12V input types

Part Number	Output Voltage (V)	Output Current Each Output (mA)	Package Style
NMXSXX05SO	5	1000	1
NMXSXX12SO	12	470	
NMXSXX15SO	15	400	

dual output types - 5V and 12V input types

Part Number	Output Voltage (V)	Output Current Each Output (mA)	Package Style
NMXDXX05SO	±5	500	2
NMXDXX12SO	±12	235	
NMXDXX15SO	±15	200	

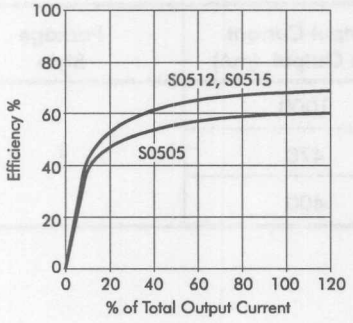
typical isolation capacitance (pF)

Part Number	Output Voltage (V)		
	05	12	15
NMXD05XXSO	30.5	37.7	36.6
NMXD12XXSO	40.5	74.8	65.7
NMXS05XXSO	37.4	37.1	33.3
NMXS12XXSO	46.6	55.0	60.0

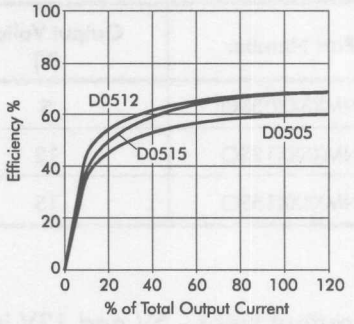
Note : All data taken at T_A=25°C.

typical characteristics

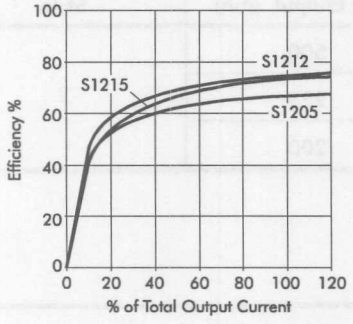
NMXS05 series



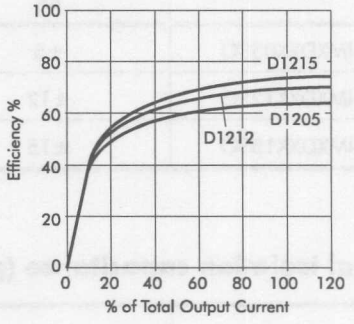
NMXD05 series



NMXS12 series



NMXD12 series



Note : All data taken at T_A=25°C.

mean time to failure (MTTF) in thousands of hours

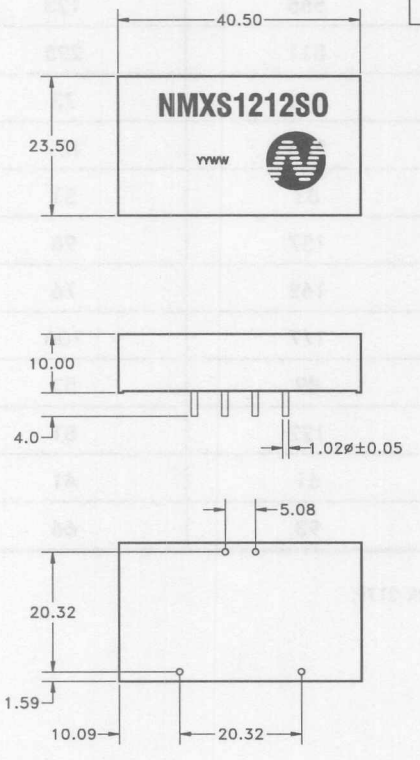
Part Number	–25°C	25°C	70°C
NMXD0505SO	780	565	123
NMXS0505SO	1059	811	225
NMXD0512SO	174	146	73
NMXS0512SO	314	265	137
NMXD0515SO	96	83	51
NMXS0515SO	182	157	98
NMXD1205SO	196	162	76
NMXS1205SO	209	177	106
NMXD1212SO	104	89	53
NMXS1212SO	143	122	81
NMXD1215SO	70	61	41
NMXS1215SO	107	93	66

Note : MTTF figures derived from hybrid model of MIL-HDBK-217F.

outline dimensions

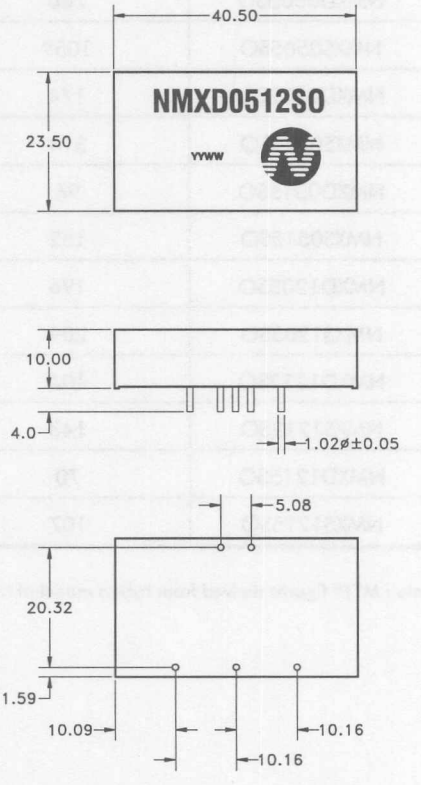
single output types

1

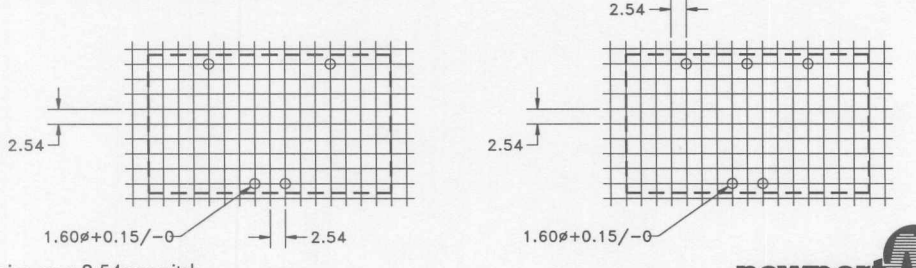


dual output types

2



recommended footprint details



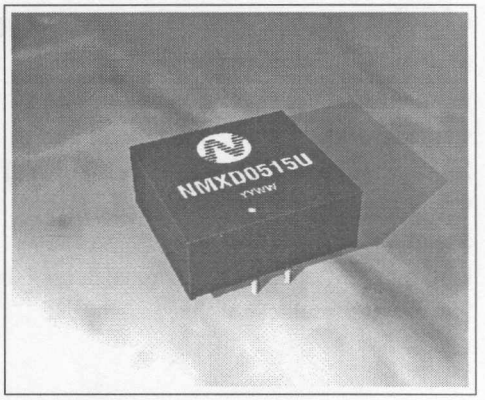
All pins on a 2.54mm pitch.

All dimensions in mm XX.X ±0.50, XX.XX ±0.25

newport technology

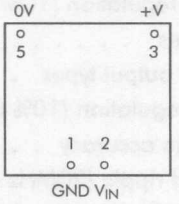
features

- Industry Standard Pinout
- Pin Compatible with NMXSO
- 1kVDC Isolation
- Single or Dual Output
- Low Profile Package
- Efficiency to 85%
- Power Density 0.85W/cm^3
- 5V & 12V Input
- 5V, 12V and 15V Output
- Footprint 5.88 cm^2
- UL94-V0 Package
- No Heatsink Required
- Internal SMD Construction
- Toroidal Magnetics
- Fully Encapsulated
- No External Components Required
- MTTF up to 900 Thousand Hours
- PCB Mounting
- Custom Solutions Available

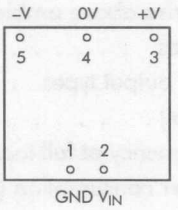


pin connections

Single Output Type (top view)



Dual Output Type (top view)



decription

The NMXU ultra-miniature 5W DC-DC Converters offer an extremely small package whilst maintaining an industry-standard footprint. The four-fold increase in power density over 2" square devices releases over 19cm^2 of board area when upgrading. The devices are particularly suited for use in distributed power systems where there is low variation in the bus voltage levels.

PRELIMINARY

Notice : This is not a final specification.
Some parametric limits may be subject to change.

absolute maximum ratings over operating free air* temperature range

Input voltage V_{IN} NMX05 types	7V
Input voltage V_{IN} NMX12 types	15V
Output power	5W
Isolation voltage (flash tested for 1 second)	1000VDC
Operating free air temperature range	0°C to 70°C
Storage temperature range	–55°C to 100°C
lead temperature 1.5mm from case for 10 seconds	300°C
Short circuit protection	1 second max.

electrical specifications

(measured at T_A=25°C, at nominal input voltage)

Input voltage range NMX05 types	5V±10%
Input voltage range NMX12 types	12V±10%
Load voltage regulation (10% to 100% full load)	
5V output types	7% typ. 12% max.
12V and 15V output types	5% typ. 7.5% max.
Line voltage regulation (10% to 100% full load)	1.1%
Output voltage accuracy	See tolerance envelope graph
Input reflected ripple (20MHz Band Limited)	200mV p-p max.
Output ripple (20 MHz Band limited)	125mV p-p max.
Insulation resistance at 1000VDC	1000MΩ min.
Efficiency at full load	85% typ. 75% min.
Temperature rise above ambient at full load	
5V output types	30°C typ.
12V and 15V output types	20°C typ.
Weight (typical)	10 grams
Switching frequency at full load (typical)	70kHz
No load power consumption (typical)	500mW

* Free air – requires a minimum of 10mm air space around the component.

selection guide

single output types - 5V and 12V input types

Part Number	Output Voltage (V)	Output Current Each Output (mA)	Package Style
NMXSXX05U	5	1000	1
NMXSXX12U	12	417	
NMXSXX15U	15	333	

dual output types - 5V and 12V input types

Part Number	Output Voltage (V)	Output Current Each Output (mA)	Package Style
NMXDXX05U	±5	500	2
NMXDXX12U	±12	208	
NMXDXX15U	±15	167	

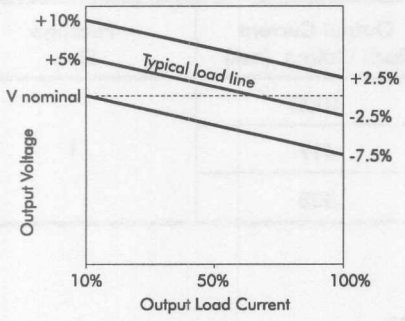
typical isolation capacitance (pF)

Part Number	Output Voltage (V)		
	05	12	15
NMXS05XXU	30.6	31.2	32.6
NMXD05XXU	31.5	33.0	34.2
NMXS12XXU	32.5	51.9	54.1
NMXD12XXU	34.7	52.9	59.9

Note : All data taken at T_A=25°C.

typical characteristics

tolerance envelope



Note : All data taken at T_A=25°C.

mean time to failure (MTTF) in thousands of hours

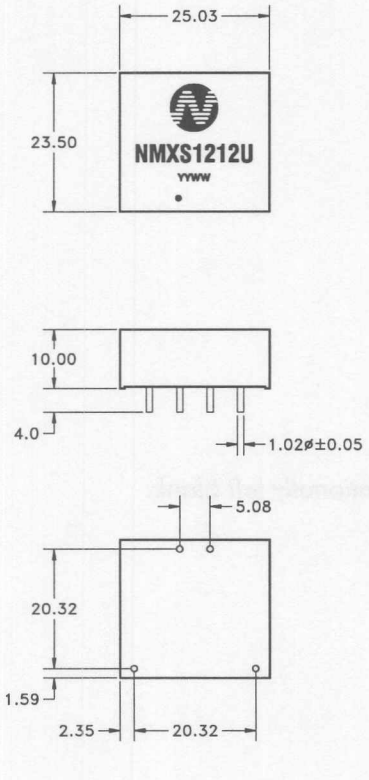
Part Number	–25°C	25°C	70°C
NMXS0505U	913	792	694
NMXD0505U	907	779	673
NMXS0512U	179	158	140
NMXD0512U	179	158	140
NMXS0515U	98	86	77
NMXD0515U	98	86	77
NMXS1205U	269	233	205
NMXD1205U	269	233	205
NMXS1212U	122	107	94
NMXD1212U	122	107	94
NMXS1215U	78	68	61
NMXD1215U	78	68	61

Note : MTTF figures derived from hybrid model of MIL-HDBK-217F.

outline dimensions

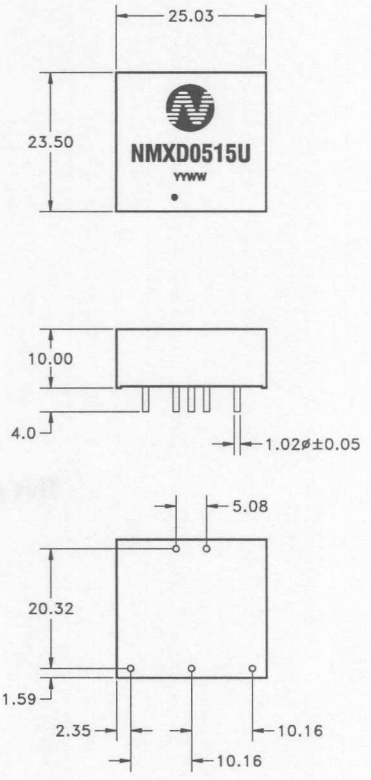
single output types

1

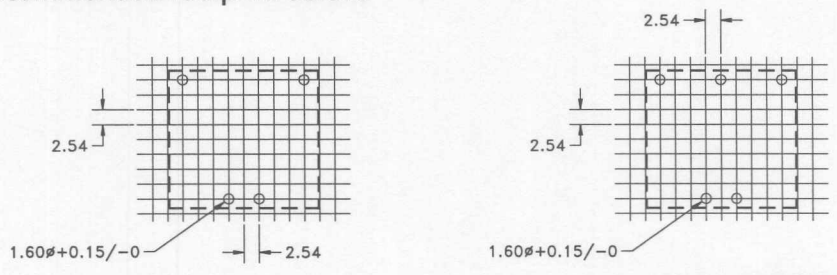


dual output types

2



recommended footprint details



All pins on a 2.54mm pitch.

All dimensions in mm XX.X ±0.50, XX.XX ±0.25

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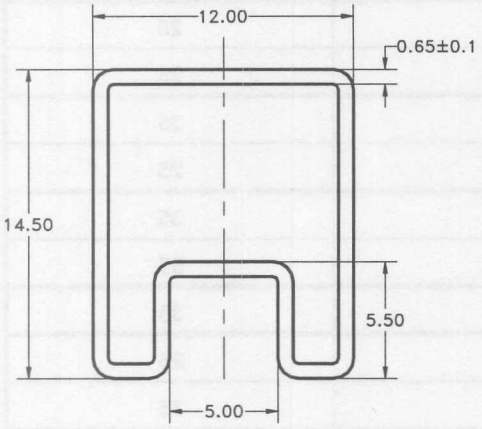
Part Number	Tube Style	Quantity per Tube
LMEXXXXD	1	35
LMEXXXXS	2	35
NMAXXXXD	1	25
NMAXXXXS	2	25
NMDXXXXD	1	25
NMDXXXXS	2	25
NMEXXXXD	1	35
NMEXXXXS	2	35
NMEXXXXTM	4	35
NMFXXXXD	1	25
NMFXXXXM	3	35
NMFXXXXS	2	25
NMHXXXXD	1	25
NMHXXXXS	2	25
NMLXXXXS	2	28
NMSXXXX	5	15
NMVXXXXD(A)	1	25
NMVXXXXS(A)	2	25
NMXDXXXXSO	6	12
NMXSXXXXSO	6	12
NMXDXXXXU	6	19
NMXSXXXXU	6	19

PACKAGING DETAILS

Outline Dimensions and Quantities

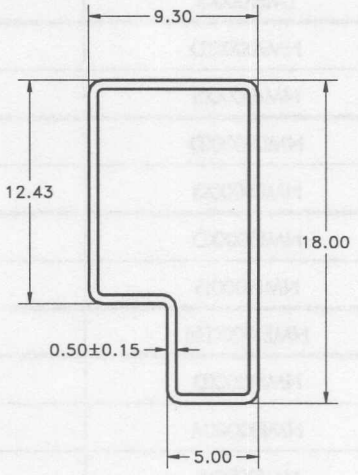
1

tube length = 530mm±2.00mm



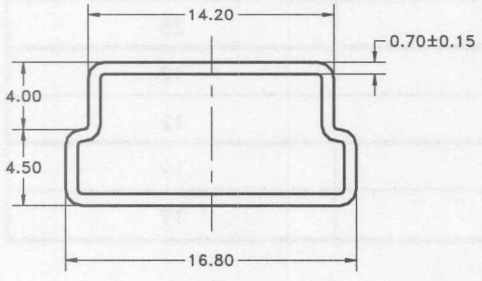
2

tube length = 520mm±2.00mm



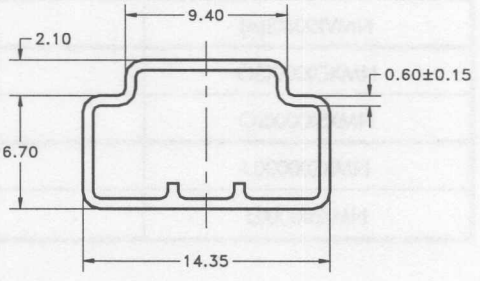
3

tube length = 475mm±2.00mm



4

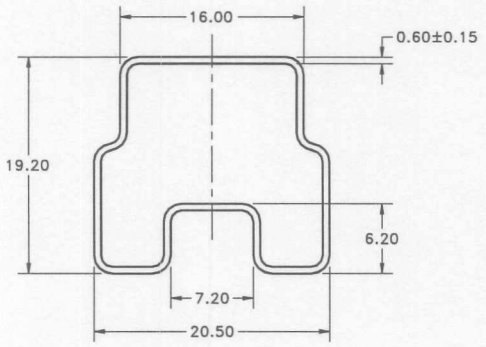
tube length = 475mm±2.00mm



All dimensions in mm XX.XX±0.50

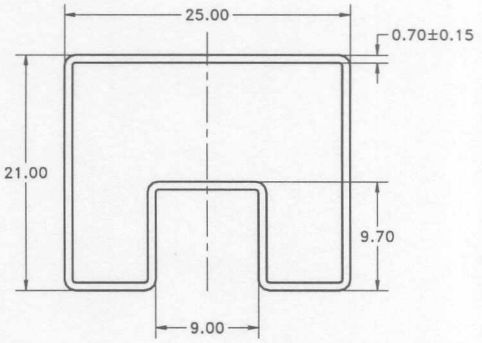
5

tube length = 520mm±2.00mm



6

tube length = 520mm±2.00mm



All dimensions in mm XX.XX±0.50

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terminology

The data sheet specification for DC-DC converters contains a large quantity of information. This terminology is aimed at ensuring the user is interpreting the data provided correctly and obtaining the necessary information for their circuit application.

absolute maximum ratings :

The absolute maximum ratings are the limits to which the devices can be stressed without causing permanent and irreparable damage. These limits are not the normal operating or functional limits of the devices and operating at the absolute maximum ratings will produce different parametric results to those quoted in the data sheet.

input voltage range :

The range of input voltage that the device can tolerate and maintain functional performance.

load voltage regulation :

The change in output voltage over the specified change in output load. Usually specified as a percentage of the nominal output voltage, for example if a 1V change in output voltage is measured on a 12V output device, load voltage regulation is 8.3%. For unregulated devices the load voltage regulation is specified over the load range 10% to 100% of full load.

line voltage regulation :

The change in output voltage for a given change in input voltage, expressed as percentages. For example, assume a 12V input, 5V output device exhibited a 0.5V change at the output for a 1.2V change at the input, line regulation would be 1 %/%.

output voltage accuracy :

The proximity of the output voltage to the specified nominal value. This is given as a tolerance envelope for unregulated devices with the nominal input voltage applied. For example, a 5V specified output device at 100% load may exhibit a measured output voltage of 4.75V, i.e. a voltage accuracy of -5%).

input and output ripple :

The amount of voltage droop at the input or output between switching cycles. The value of voltage ripple is a measure of the storage ability of the filter capacitors.

input to output isolation :

The dielectric breakdown strength test between input and output circuits. This is the isolation voltage the device is capable of withstanding for a specified time, usually 1 second. (NMV series is 1 minute)

insulation resistance :

The resistance between input and output circuits. This is usually measured at 500V DC

efficiency at full load :

The ratio of power delivered from the device to power supplied to the device when the part is operating under 100% load conditions.

temperature drift :

The change in voltage, expressed as a percentage of the nominal, per degree change in ambient temperature. This parameter is related to several other temperature dependent parameters, mainly internal component drift.

temperature above ambient :

The internal temperature rise developed by the device under full load conditions. This is related to efficiency.

switching frequency :

The nominal frequency of operation of the switching circuit inside the DC-DC converter. The ripple observed on the input and output pins is usually twice the switching frequency due to full wave rectification and the push-pull configuration of the driver circuit.

no load power consumption :

This is a measure of the switching circuits requirement to function, it is determined with zero output load and is a limiting factor for the total efficiency of the device.

isolation capacitance :

The input to output coupling capacitance. This is not actually a capacitor, but the parasitic capacitive coupling between the transformer primary and secondary windings. Isolation capacitance is typically measured at 1MHz to reduce the possibility of the on-board filter capacitors affecting the results.

mean time to failure (MTTF) :

These figures are calculated expected device lifetime figures using the hybrid circuit model of MIL-HDBK-217F.

noise :

Input conducted noise is given in the line conducted spectra for each DC-DC converter (see EMC issues for further details). Noise is affected significantly by pcb layout, measurement system configuration, terminating impedance etc. and is difficult to quote reliably and with any accuracy other than via a spectrum analysis type plot. There will be some switching noise present on top of the ripple, however, most of this is easily reduced by use of small capacitors or filter inductors as shown in the application notes.

temperature derating curve :

The component will operate over a wider temperature range if less power is drawn from the output and the device is already running. The temperature derating curve shows the operating power-temperature range once the converter is started.

There are almost limitless applications for DC-DC converters since these components provide the basic power supply function on many circuit boards. These application notes will concentrate on using the converters in some specific applications as well as highlighting good design practice for the circuit around the DC-DC converter. Where detailed designs are given, they are for illustrative purposes to demonstrate a principle, even though the circuit has been built to solve a particular circuit or design problem.

isolation

One of the main features of the majority of Newport Technology DC-DC converters is their high galvanic isolation capability. This allows several variations on circuit topography by using a single DC-DC converter.

The basic input to output isolation can be used to provide either a simple isolated output power source, or to generate different voltage rails and/or dual polarity rails (see figure 1).

These configurations are most often found in instrumentation, data processing and other noise sensitive circuits where it is necessary to isolate the load and noise presented to the local power supply rails from that of the entire system. Usually local supply noise appears as common mode noise at the converter and does not pollute the main system power supply rails.

The isolated positive output can be connected to the input ground rail to generate a negative supply rail if required. Since the output is isolated from the input the choice of reference for the output side can be relatively arbitrary, for example an additional single rail can be generated above the main supply rail or offset by some other DC value (see figure 2).

Regulated converters need more consideration than the unregulated types for mixing the reference level. Essentially the single supply rail has a regulator in its $+V_O$ rail only,

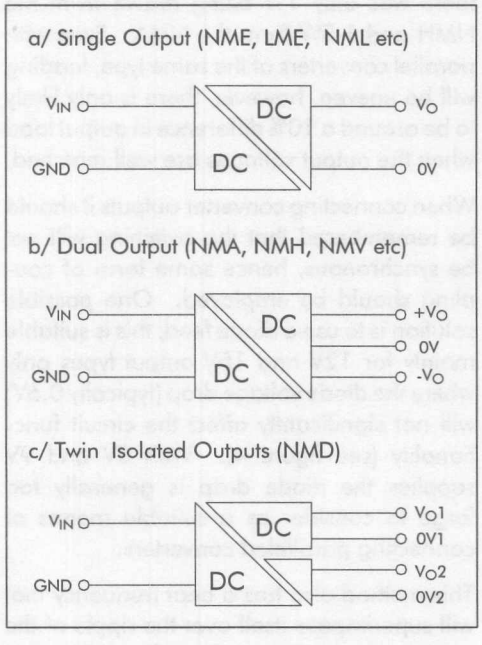


Figure 1 : *Standard Isolated Configurations*

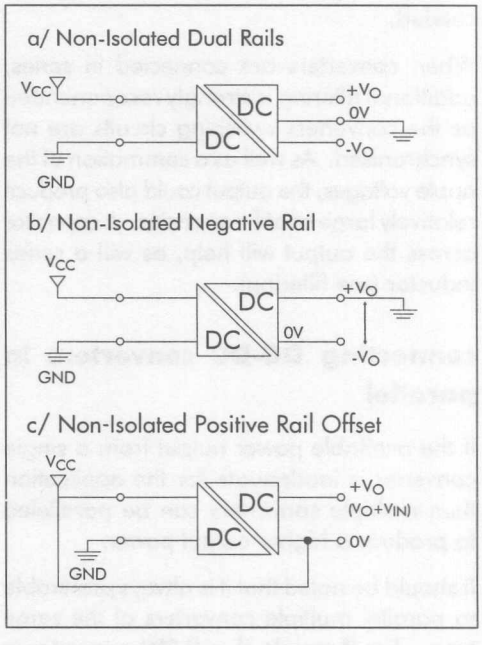


Figure 2 : *Alternative Supply Configurations*

hence referencing the isolated ground will only work if all the current return is through the DC-DC and not via other external components (e.g. diode bias, resistor feed). Having an alternative return path can upset the regulation and the performance of the system may not equal that of the converter.

connecting DC-DC converters in series

Galvanic isolation of the output allows multiple converters to be connected in series simply by connecting the positive output of one converter to the negative of another (see figure 3). In this way non-standard voltage rails can be generated, however, the current output of the highest output voltage converter should not be exceeded.

When converters are connected in series, additional filtering is strongly recommended as the converters switching circuits are not synchronised. As well as a summation of the ripple voltages, the output could also produce relatively large beat frequencies. A capacitor across the output will help, as will a series inductor (see filtering).

connecting DC-DC converters in parallel

If the available power output from a single converter is inadequate for the application then multiple converters can be paralleled to produce a higher output power.

It should be noted that it is always preferable to parallel multiple converters of the same type. For example if a 2.5W converter is required, then either 2 NMHs should be used or 3 NMAs, not an NMH and NMA. The reason for this is that the output voltages are not sufficiently well matched to guarantee that an NMH would supply twice as much as an NMA and the situation could occur where there was only 1W being drawn from the NMH and 1.5W from the NMA. Even with parallel converters of the same type, loading will be uneven, however, there is only likely to be around a 10% difference in output load when the output voltages are well matched.

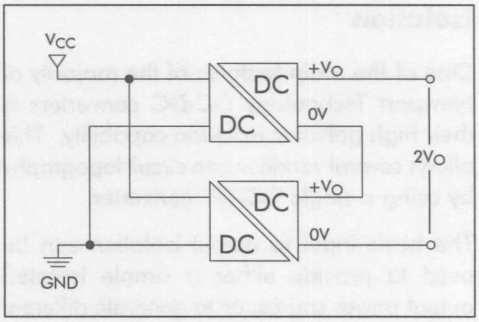


Figure 3 : *Connecting DC-DC Converters in Series*

When connecting converter outputs it should be remembered that the switching will not be synchronous, hence some form of coupling should be employed. One possible solution is to use a diode feed, this is suitable mainly for 12V and 15V output types only where the diode voltage drop (typically 0.6V) will not significantly affect the circuit functionality (see figure 4). With 5V and 9V supplies the diode drop is generally too large to consider as a suitable means of connecting paralleled converters.

This method also has a beat frequency that will superimpose itself over the ripple of the two converters, this can be reduced by using an external capacitor at the paralleled output.

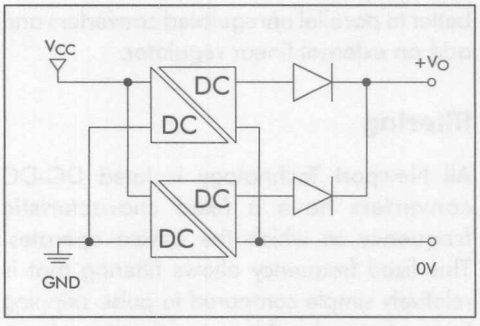


Figure 4 : *Diode Coupled Paralleled DC-DC Converters*

The preferred method of connecting converters in parallel is via series inductors on the output (see figure 5). This configuration not only has a lower loss of voltage than the diode method, but by suitable choice of inductor and an additional external capacitor, the beat frequency can be significantly reduced, as will the ripple from each converter. Suitable values are given in the table below, these typically reduce the beat and ripple frequencies by a factor of 10.

recommended values for paralleled DC-DC Converters

The capacitance value used (C_{OUT}) should be approximately 1μF per parallel channel (i.e. for 2 parallel single output converters, 2μF between the common positive output and 0V).

The same comments can be applied to the input circuit for converters whose inputs are paralleled and similar values for inductance and input capacitance should be used as shown above.

In general paralleling converters should only be done when essential and a higher power single converter is always a preferable solution. There should always be a correction factor of the maximum power rating to allow for mismatch between converters and a select at full load test is recommended to ensure the output voltage is matched to within 1% or 2%. In general a factor of 0.9 should be used to provide a power safety margin per converter (e.g. 2 NMH converters paralleled should only be used up to a power level of 3.6W, not their 4W maximum). At most three DC-DC converters can be paralleled with a high

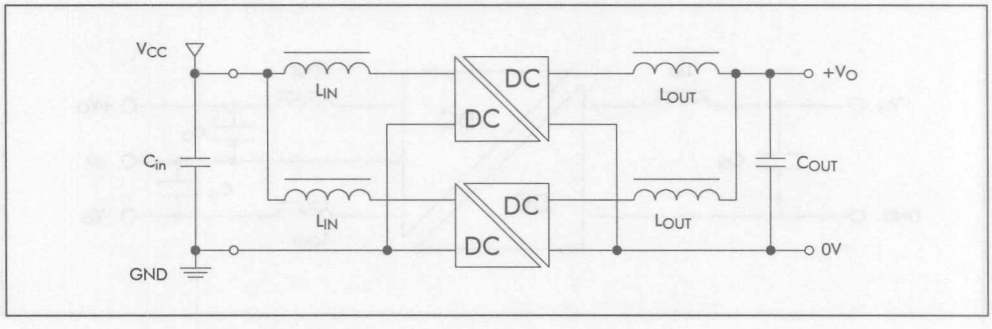


Figure 5 : *Fully Filtered Paralleled DC-DC Converters*

Product Range	Output Voltage	Inductance (μH)
LME NMA NMD NME NMH NML NMV	3.3	33
	5	47
	9	100
	12	220
	15	330

Table 1 : *Parallel Output Inductors*

level of confidence in the overall performance. If the circuit needs more power than three converters in parallel, then a single converter with a much higher power rating should be considered.

Regulated output DC-DC converters should not be paralleled since their output voltage would need to be very accurately matched to ensure even loading (to within the tolerance of the internal linear regulator). Paralleling regulated converters could cause one of the parts to be overloaded. If a high power regulated supply is required, it would be better to parallel unregulated converters and add an external linear regulator.

filtering

All Newport Technology isolated DC-DC converters have a fixed characteristic frequency at which the device operates. This fixed frequency allows filtering that is relatively simple compared to pulse-skipping types. In a pulse skipping converter a large range of frequencies are encountered as the device adjusts the pulse interval for loading conditions.

When reducing the ripple from the converter, at either the input or the output, there are several aspects to be considered. Newport Technology recommend filtering using simple passive LC networks at both input and output (see figure 6). A passive RC network could be used, however, the power loss through a resistor is considered too high. The self resonant frequency of the inductor needs to be significantly higher than the characteristic frequency of the DC-DC (typically 100kHz for Newport Technology DC-DC converters). The DC current rating

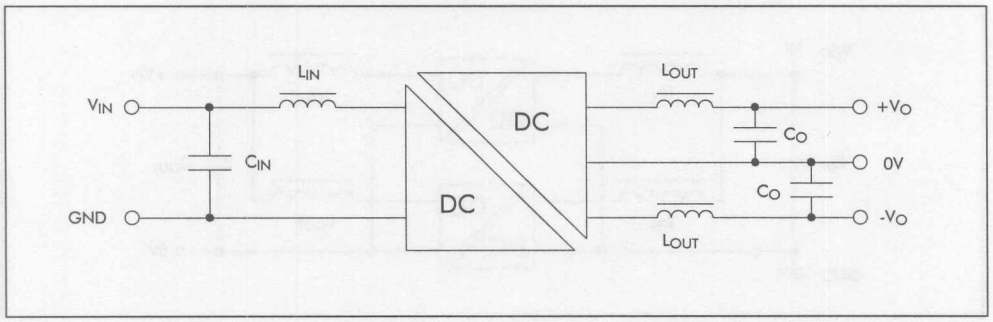


Figure 6 : *Input and Output Filtering*

of the inductor also needs consideration, a rating of approximately twice the supply current is recommended. The DC resistance of the inductor is the final consideration that will give an indication of the DC power loss to be expected from the inductor.

The value of inductor and capacitor to use is given in the table below for the majority of Newport Technology DC-DC converters. The capacitance is chosen to form a pi filter to match the input or output capacitor of the DC-DC converter. The inductor is chosen to cause heavy attenuation of the characteristic frequency when combined with the given capacitors.

recommended values for filtered DC-DC converters

Those converters that feature an internal linear regulator (eg NMF, NMXSO) do not require external filtering at the output but can benefit from the above filter combinations at the input (see table 2).

limiting inrush current

Using a series inductor at the input will limit the current that can be seen at switch on (see figure 7). If we consider the circuit without the series inductor, then the input current is given by:

$$i = \frac{V}{R} \exp\left(\frac{-t}{RC}\right)$$

When the component is initially switched on (i.e. t=0) this simplifies to:

$$i = \frac{V}{R}$$

This would imply that for a 5V input, with say 50mΩ track and wire resistance, the inrush current could be as large as 100A, this could cause a problem for the DC-DC converter.

A series input inductor therefore not only filters the noise from the internal switching circuit, but also limits the inrush current at switch on.

Product Range	Input Voltage	Inductance/ Capacitance	Output Voltage	Inductance/ Capacitance
LME NMA NME NMH NMD NMV	3.3	33μH / 1.5μF	3.3	33μH / 1.5μF
	5	47μH / 1.0μF	5	47μH / 1.0μF
	12	220μH / 1.0μF	9	100μH / 1.0μF
	24	470μH / 470nF	12	220μH / 1.0μF
	48	680μH / 180nF	15	330μH / 1.0μF

Table 2 : *Recommended Values for Filtered DC-DC's*

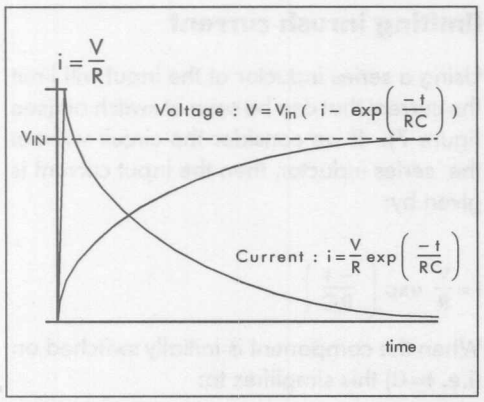


Figure 7 : *Input Current & Voltage at Switch On*

maximum output capacitance

A simple method of reducing the output ripple is simply to add a large external capacitor. This can be a low cost alternative to the LC filter approach, although not as effective. There is also the possibility of causing start up problems if the output capacitance is too large.

With a large output capacitance, at switch on there is no charge on the capacitors and the DC-DC converter immediately experiences a large current demand at its output. The inrush current can be so large as to exceed the ability of the DC-DC converter and the device can go into an undefined mode of operation. In the worst case scenario the device can give a lower than expected DC output with a very high ripple. The DC-DC converter may survive this condition, however, the circuit being supplied is unlikely to function under this supply scheme.

Newport Technology recommend a maximum safe operating value of 10μF for the output per channel. When used in conjunction with a series output inductor this value can be raised to 47μF should extremely low ripple be required.

settling time

The main reason for not fitting a series inductor internally is that many applications require a fast power on time (there is also a size constraint with our miniature parts). When the power on voltage is a controlled fast ramp, then the output can respond within 500μs of the input reaching its target voltage (measured on a range of NMA and NMH components under full output load without external filters). The use of external filters and additional input or output capacitance will slow this reaction time. It is therefore left to the designer to decide on the predominant factors affecting their circuit; settling time or noise performance.

overload protection

Although the use of filtering will prevent excessive current at power-on, under normal operating conditions, there is no protection against an output circuit taking excessive power or even going short-circuit. When this happens the DC-DC converter will take a large input current to try to supply the output, eventually the converter will overheat and destroy itself if this condition is not rectified (short circuit overload is only guaranteed for 1s on an unregulated part).

There are several ways to prevent overload at the outputs destroying the DC-DC converter, the simplest being a straight forward fuse, sufficient tolerance for inrush current is required to ensure the fuse does not blow on

power-on (see figure 8). Another simple scheme that can be applied is a circuit breaker.

There is also the potential to add some intelligence to the overload scheme by either detecting the input current, or the output voltage (see figure 9). The simplest implementation for overload protection at the input is to have the device supplied via a linear regulator with an internal thermal shutdown facility. This does however reduce the overall efficiency significantly.

If there is an intelligent power management system at the input, using a series resistor (in place of the series inductor) and detecting the voltage drop across the device to signal the management system can be used. A similar scheme can be used at the output to determine the output voltage, however, if the management system is on the input side, the signal will need to be isolated from the controller to preserve the system isolation barrier (see figure 10).

The thermal dissipation in a series resistor on the output can also be used to determine overloading and preserve the isolation barrier. If a thermistor or other thermally sensitive device is mounted close to the resistor this can be used to indicate an overload condition. System temperature will also need to be known to provide a suitable offset for different operating environments.

There are several other current limiting techniques that can be used to detect an overload situation, the suitability of these is left to the designer. The most important thing to consider is how this information will be used. If the system needs to signal to a controller the location or module causing the overload some form of intelligence will be needed. If the device simply needs to switch off, a simple fuse type arrangement will be adequate.

All Newport Technology DC-DC converters which include an internal linear regulator have a thermal overload shut-down condition which protects these devices from excessive overload. If this condition is to be used to inform a power management system the most suitable arrangement is the output voltage detector (see figure 10a), since this will fall to near zero on shut-down. A thermal probe on the case of the DC-DC converter is also a possible solution.

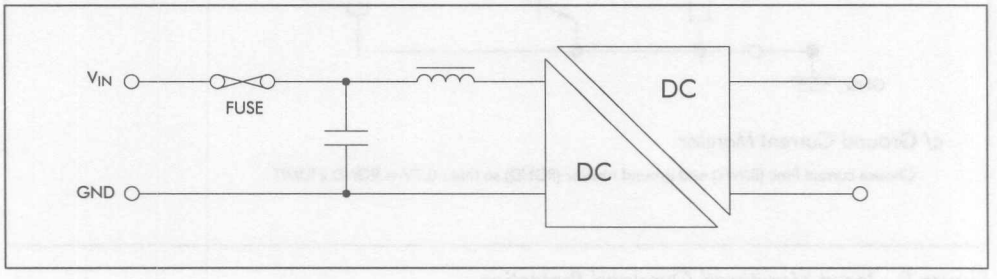


Figure 8 : *Simple Overload Protection*

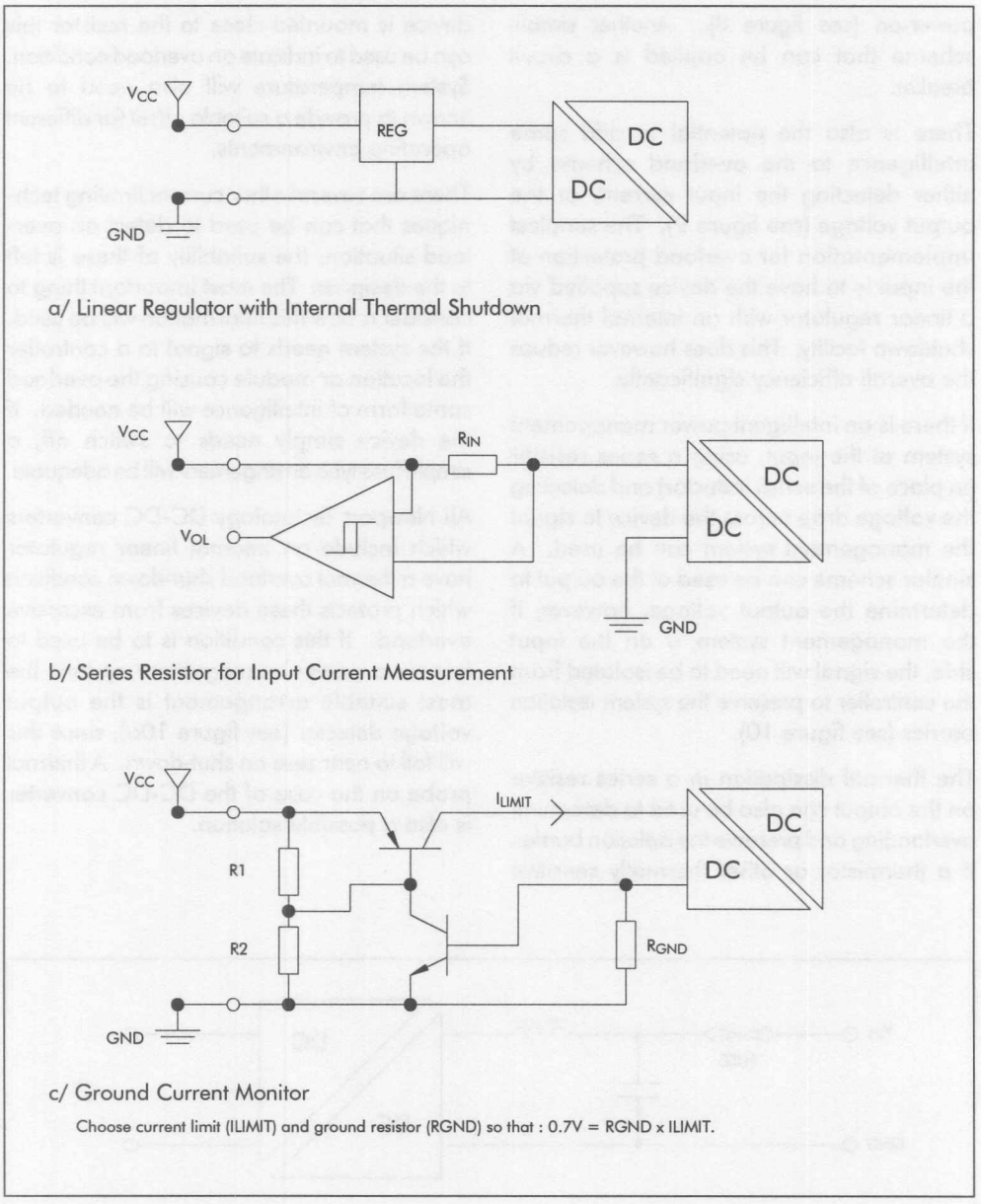


Figure 9 : *Input Monitored Overload Protection*

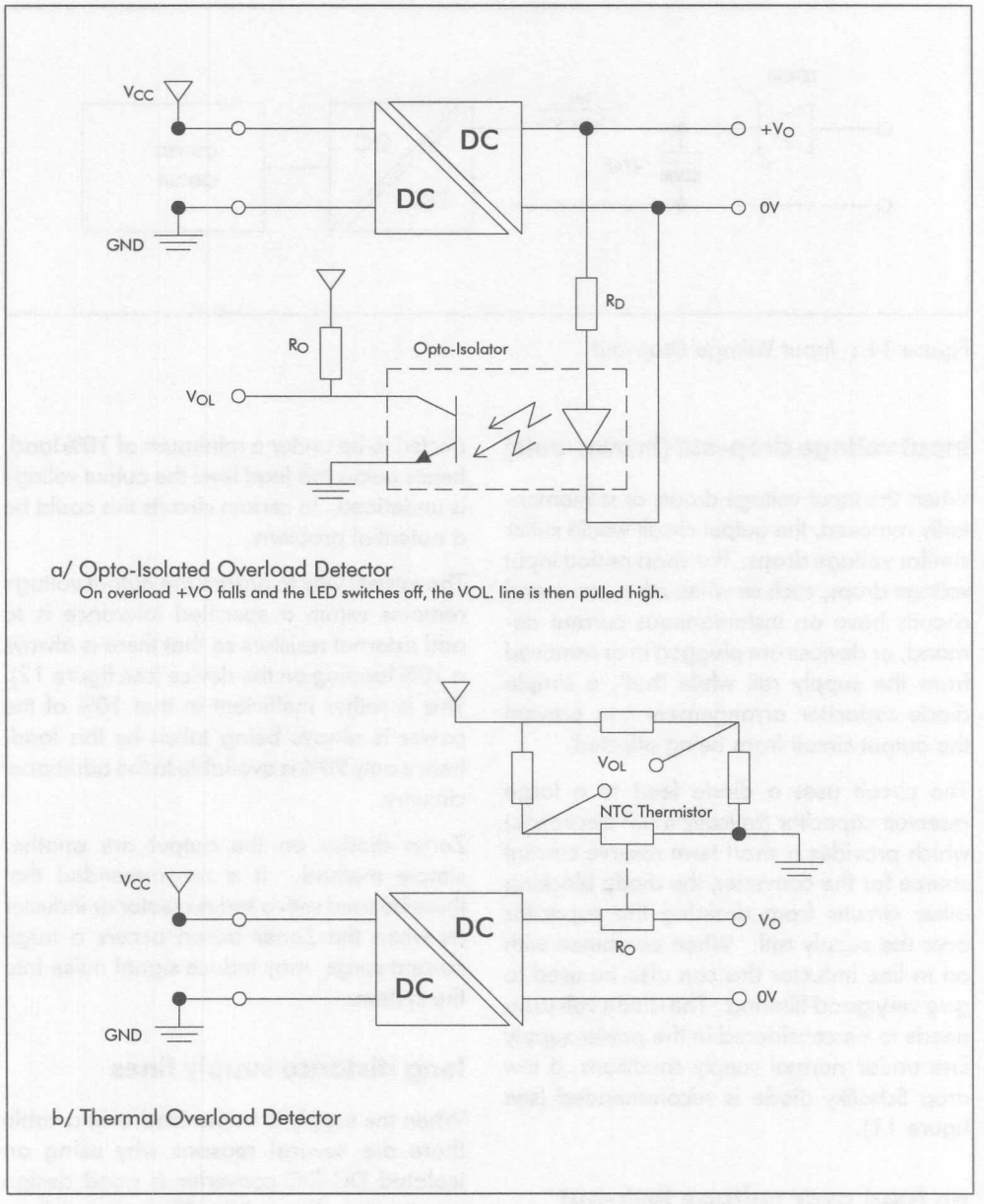


Figure 10 : *Ouput Monitored Overload Protection*

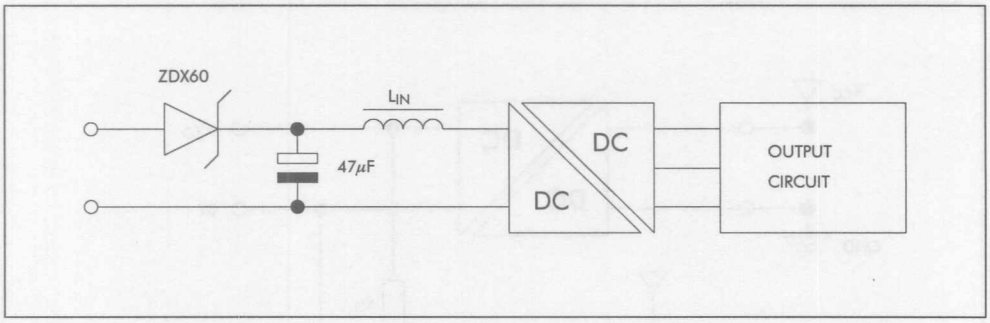


Figure 11 : *Input Voltage Drop-out*

input voltage drop-out (brown-outs)

When the input voltage drops, or is momentarily removed, the output circuit would suffer similar voltage drops. For short period input voltage drops, such as when other connected circuits have an instantaneous current demand, or devices are plugged in or removed from the supply rail while 'hot', a simple diode-capacitor arrangement can prevent the output circuit from being effected.

The circuit uses a diode feed to a large reservoir capacitor (typically 47uF electrolytic) which provides a short term reserve current source for the converter, the diode blocking other circuits from draining the capacitor over the supply rail. When combined with an in line inductor this can also be used to give very good filtering. The diode volt drop needs to be considered in the power supply line under normal supply conditions, a low drop Schottky diode is recommended (see figure 11).

no load over voltage lock-out

Unregulated DC-DC converters are expected to be under a minimum of 10% load, hence below this load level the output voltage is undefined. In certain circuits this could be a potential problem.

The easiest way to ensure the output voltage remains within a specified tolerance is to add external resistors so that there is always a 10% loading on the device (see figure 12). This is rather inefficient in that 10% of the power is always being taken by this load, hence only 90% is available to the additional circuitry.

Zener diodes on the output are another simple method. It is recommended that these be used with a series resistor or inductor as when the Zener action occurs a large current surge may induce signal noise into the system.

long distance supply lines

When the supply is transmitted over a cable there are several reasons why using an isolated DC-DC converter is good design practice (see figure 13). The noise pick up and EMC susceptibility of a cable is high compared to a pcb track, by isolating the

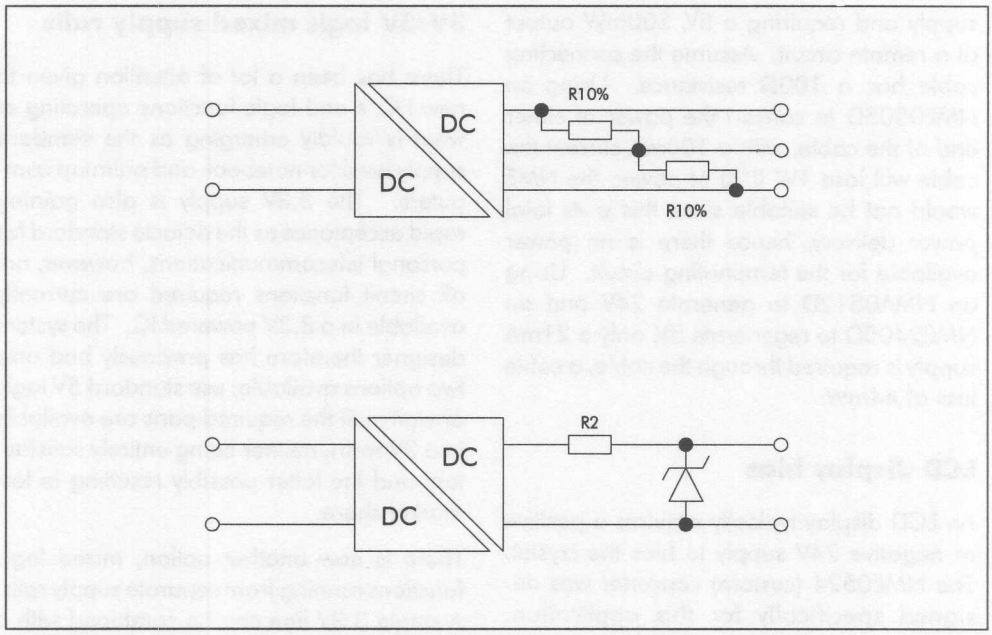


Figure 12 : *No Load Over Voltage Lock-out*

cable via a DC-DC converter at either end, any cable pick-up will appear as common mode noise and should be self cancelling at the converters.

Another reason is to reduce the cable loss by using a high voltage, low current power transfer through the cable and re-converting at the terminating circuit. This will also reduce noise and EMC susceptibility since the noise voltage required to affect the rail is also raised.

For example, compare a system having a 5V

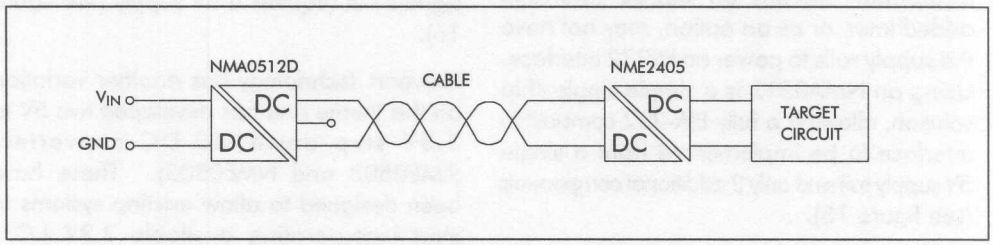


Figure 13 : *Long Distance Power Transfer*

supply and requiring a 5V, 500mW output at a remote circuit. Assume the connecting cable has a 100Ω resistance. Using an NME0505D to convert the power at either end of the cable, with a 100mA current the cable will lose 1W (I^2R) of power, the NME would not be suitable since this is its total power delivery, hence there is no power available for the terminating circuit. Using an NMA0512D to generate 24V and an NME2405D to regenerate 5V, only a 21mA supply is required through the cable, a cable loss of 44mW.

LCD display bias

An LCD display typically requires a positive or negative 24V supply to bias the crystal. The NME0524 (custom) converter was designed specifically for this application. Having an isolated 0V output this device can be configured as a +24V supply by connecting this to the GND input or a -24V supply by connecting the $+V_O$ output to GND (see figure 14).

EIA-232 interface

In a mains powered PC often several supply rails are available to power an RS232 interface. However, battery operated PC'S or remote equipment having an RS232 interface added later, or as an option, may not have the supply rails to power an RS232 interface. Using an NMA0512 is a simple single chip solution, allowing a fully EIA-232 compatible interface to be implemented from a single 5V supply rail and only 2 additional components (see figure 15).

3V/5V logic mixed supply rails

There has been a lot of attention given to new I.C.'s and logic functions operating at what is rapidly emerging as the standard supply level for notebook and palmtop computers. The 3.3V supply is also gaining rapid acceptance as the defacto standard for personal telecommunications, however, not all circuit functions required are currently available in a 3.3V powered IC. The system designer therefore has previously had only two options available; use standard 5V logic or wait until the required parts are available in a 3V form, neither being entirely satisfactory and the latter possibly resulting in lost market share.

There is now another option, mixed logic functions running from separate supply rails. A single 3.3V line can be combined with a range of DC-DC converters from Newport Technology to generate voltage levels to run virtually any standard logic or interface IC. The Newport Technology range includes dual output parts for powering analogue bipolar and amplifier functions (NMA series) as well a single output function for localised logic functions (LME, NME series). A typical example might be an RS232 interface circuit in a laptop PC using a 3.3V interface chip (such as the LT1330) which accepts 3.3V logic signals but requires a 5V supply (see figure 16).

Newport Technology has another variation on this theme and has developed two 5V to 3.3V step down DC-DC converters (LME0503 and NME0503). These have been designed to allow existing systems to start incorporating available 3.3V I.C.'s without having to redesign their power supply. This is particularly important when trying to

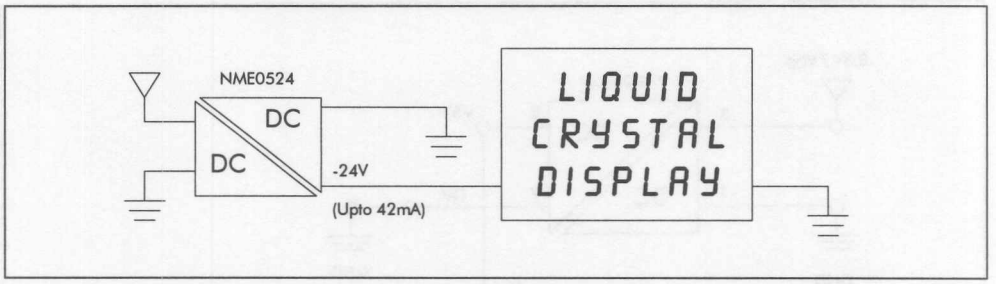


Figure 14 : *LCD Display Bias*

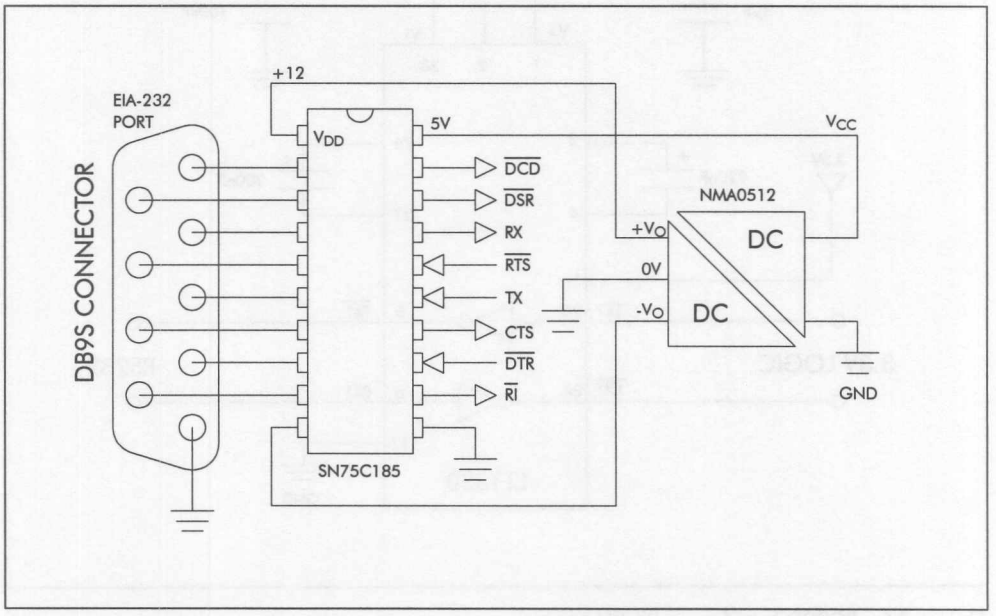


Figure 15 : *Optimised RS232 Interface*

reduce the overall power demand of a system, but not having available all of the functions at the 3.3V supply.

The main application for this range of devices are system designers who want to provide some functionality that requires a higher voltage than is available from the supply rail, or for a single localised function. Using a fully isolated supply is particularly useful in interface functions and systems maintaining separate analogue and digital ground lines.

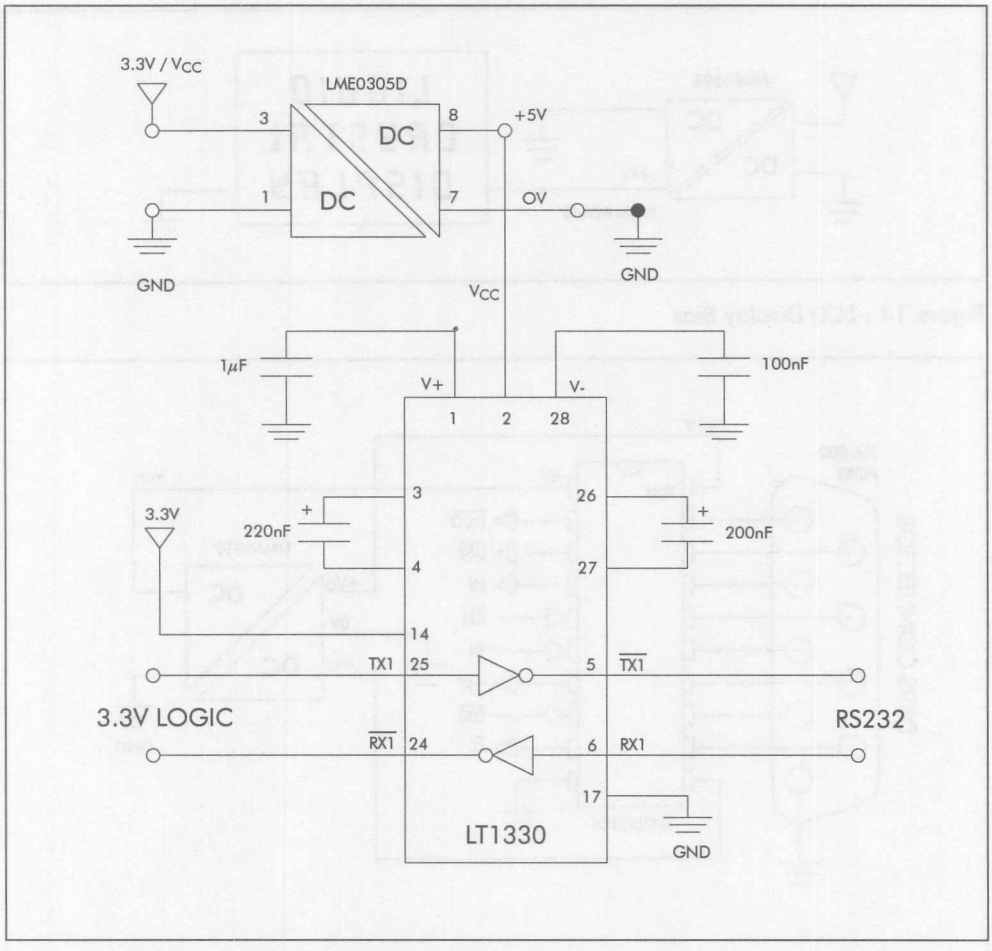


Figure 16 : *RS232 Interface with 3V Logic*

isolated data acquisition system

Any active system requiring isolation will need a DC-DC converter to provide the power transfer for the isolated circuit. In a data acquisition circuit there is also the need for low noise on the supply line, hence good filtering is required.

The circuit shown (see figure 17) provides a very high isolation barrier by using an NMV converter to provide the power isolation and SFH610 opto-isolators for the data isolation. An overall system isolation of 2.5kV is achieved.

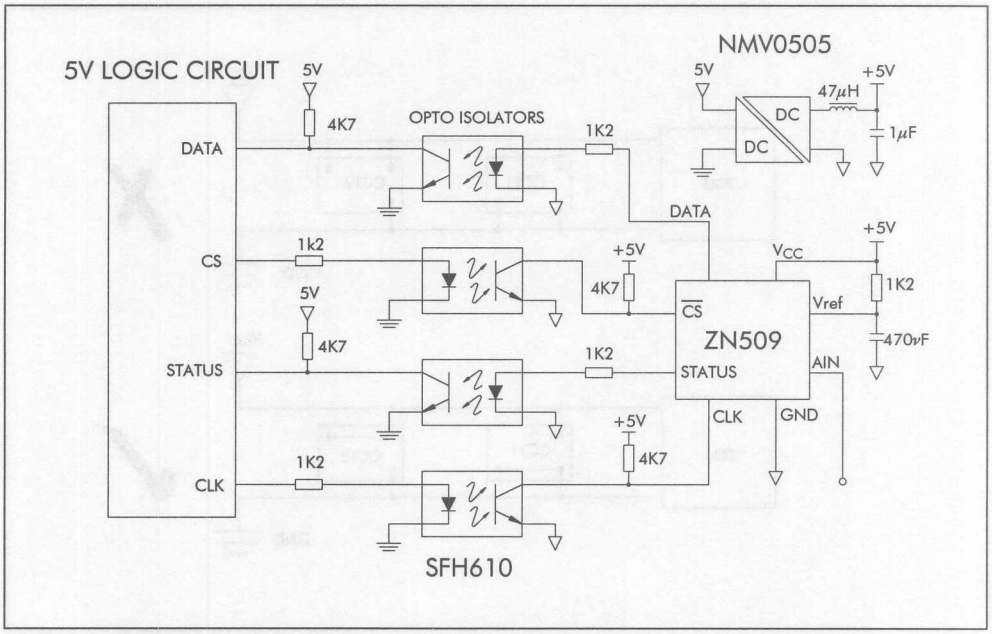


Figure 17 : *Isolated Serial ADC System*

EMC considerations

When used for isolating a local power supply and incorporating the appropriate filter circuits as illustrated above, DC-DC converters can present simple elegant solutions to many EMC power supply problems. The range of fixed frequency DC-DC converters is particularly suitable for use in EMC problem situations as the stable, fixed switching frequency gives easily characterised and easily filtered output.

The following notes give suggestions to avoiding common EMC problems in power supply circuits.

power supply considerations

- ❒ eliminate loops in supply lines (see figure 18).
- ❒ decouple supply lines at local boundaries (use RCL filters with low Q, see figure 19).
- ❒ place high speed sections close to the power line input, slowest section furthest away (reduces power plane transients, see figure 20).
- ❒ isolate individual systems where possible (especially analogue and digital systems) on both power supply and signal lines (see figure 21).

An isolated DC-DC converter can provide a

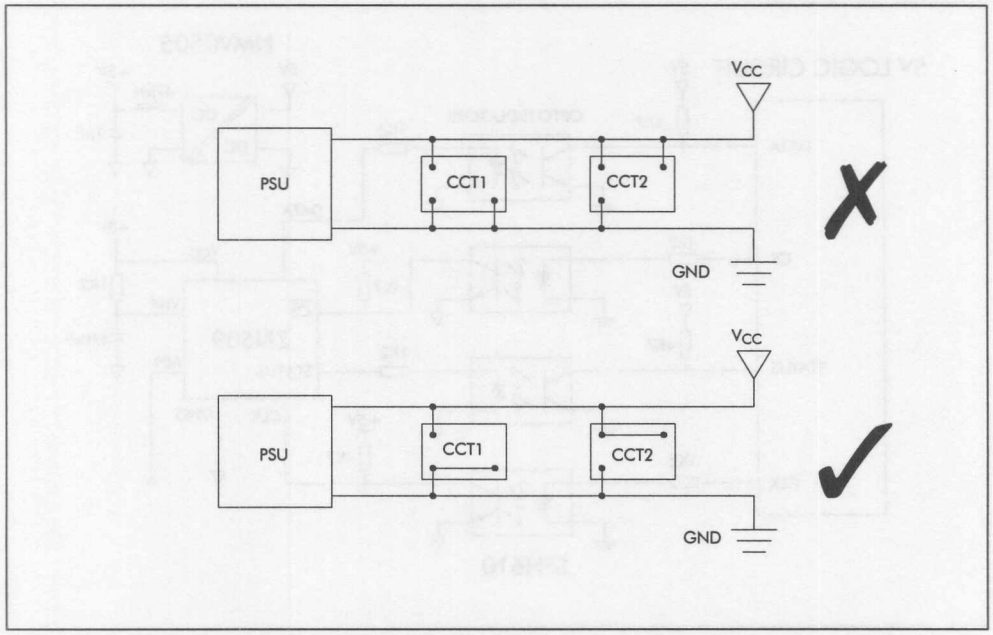


Figure 18 : *Eliminate Loops in Supply Line*

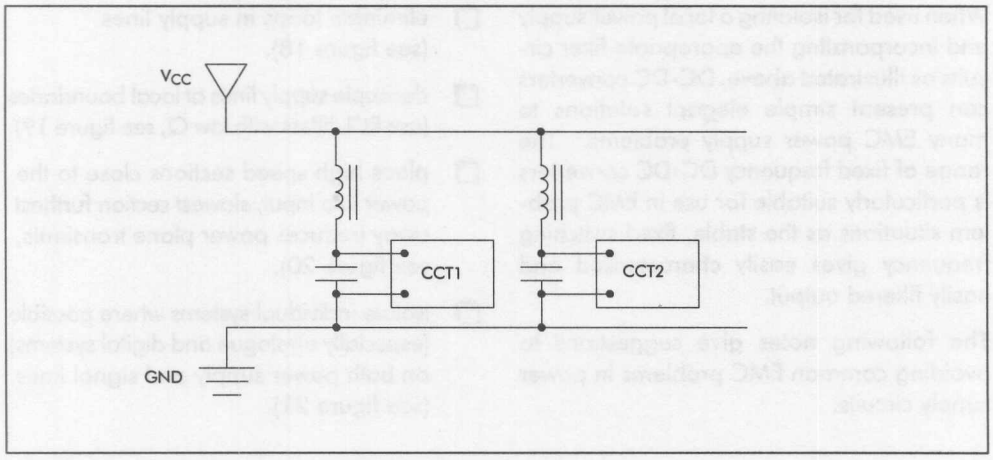


Figure 19 : *Decouple Supply Lines at Local Boundaries*

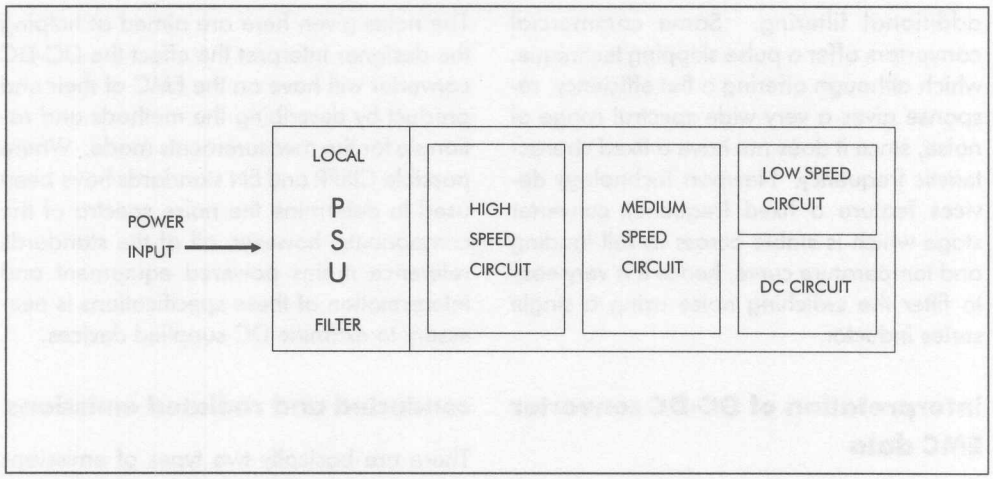


Figure 20 : *Place High Speed Circuit Close to PSU*

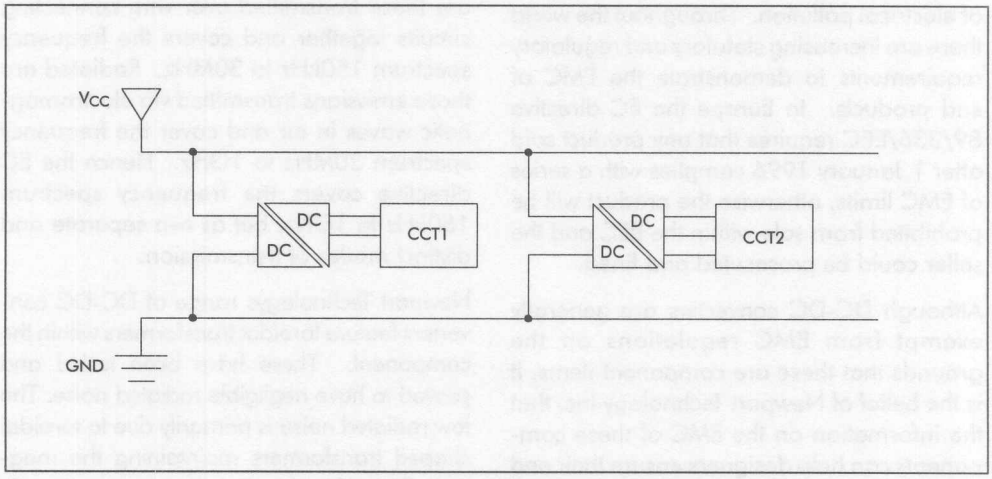


Figure 21 : *Isolate Individual Systems*

significant benefit to reducing susceptibility and conducted emission due to isolating both power rail and ground from the system supply. The range of DC-DC converters available from Newport Technology all utilise toroidal power transformers and as such have negligible EMI radiation.

Isolated DC-DC converters are switching devices and as such have a characteristic switching frequency which may need some

additional filtering. Some commercial converters offer a pulse skipping technique, which although offering a flat efficiency response gives a very wide spectral range of noise, since it does not have a fixed characteristic frequency. Newport Technology devices feature a fixed frequency converter stage which is stable across its full loading and temperature curve, hence it is very easy to filter the switching noise using a single series inductor.

interpretation of DC-DC converter EMC data

Electromagnetic compatibility (EMC) of electrical and electronic products is a measure of electrical pollution. Throughout the world there are increasing statutory and regulatory requirements to demonstrate the EMC of end products. In Europe the EC directive 89/336/EEC requires that any product sold after 1 January 1996 complies with a series of EMC limits, otherwise the product will be prohibited from sale within the EEC and the seller could be prosecuted and fined.

Although DC-DC converters are generally exempt from EMC regulations on the grounds that these are component items, it is the belief of Newport Technology Inc. that the information on the EMC of these components can help designers ensure their end product can meet the relevant statutory EMC requirements. It must be remembered however, that the DC-DC converter is unlikely to be the last component in the chain to the mains supply, hence the information quoted needs interpretation by the circuit designer to determine its impact on the final EMC of their system.

The notes given here are aimed at helping the designer interpret the effect the DC-DC converter will have on the EMC of their end product by describing the methods and rationale for the measurements made. Where possible CISPR and EN standards have been used to determine the noise spectra of the components, however, all of the standards reference mains powered equipment and interpretation of these specifications is necessary to examine DC supplied devices.

conducted and radiated emissions

There are basically two types of emissions covered by the EC directive on EMC, radiated and conducted. Conducted emissions are those transmitted over wire connecting circuits together and covers the frequency spectrum 150kHz to 30MHz. Radiated are those emissions transmitted via electromagnetic waves in air and cover the frequency spectrum 30MHz to 1GHz. Hence the EC directive covers the frequency spectrum 150kHz to 1GHz, but as two separate and distinct modes of transmission.

Newport Technologys range of DC-DC converters feature toroidal transformers within the component. These have been tested and proved to have negligible radiated noise. The low radiated noise is primarily due to toroidal shaped transformers maintaining the magnetic flux within the core, hence no magnetic flux is radiated by design. Due to the exceptionally low value of radiated emission only conducted emissions are quoted.

Conducted emissions are measured on the input DC supply line. Unfortunately no standards exist for DC supplies as most standards cover mains connected equipment.

This poses two problems for a DC supplied device, firstly no standard limit lines can be directly applied, since the DC supplied device does not directly connect to the mains, also all reference material uses the earth-ground plane a reference point. In a DC system often the 0V is the reference, however, for EMC purposes, it is probably more effective to maintain the earth as the reference, since this is likely to be the reference that the shielding or casing is connected to. Consequently all measurements quoted are referenced to the mains borne earth.

line impedance stabilisation network (LISN)

It is necessary to ensure that any measurement of noise is from the device under test (DUT) and not from the supply to this device. In mains connected circuits this is important and the mains has to be filtered prior to supply to the DUT. The same approach has been used in the testing of DC-DC converters and the DC supply to the converter was filtered to ensure that no noise from the PSU as present at the measuring instrument.

A line impedance stabilisation network (LISN) conforming to CISPR 16 specification is connected to both positive and negative supply rails and referenced to mains earth (see figure 22). The measurements are all taken from the positive supply rail with the negative rail measurement point terminated with 50Ω to impedance match the measurement channels.

shielding

At all times the DUT, LISN's and all cables connecting any measurement equipment, loads and supply lines are shielded. The shielding is to prevent possible pick-up on cables and DUT from external EMC sources (e.g. other equipment close by). The shielding is referenced to mains earth (see figure 22).

line spectra of DC-DC converters

All DC-DC converters are switching devices,

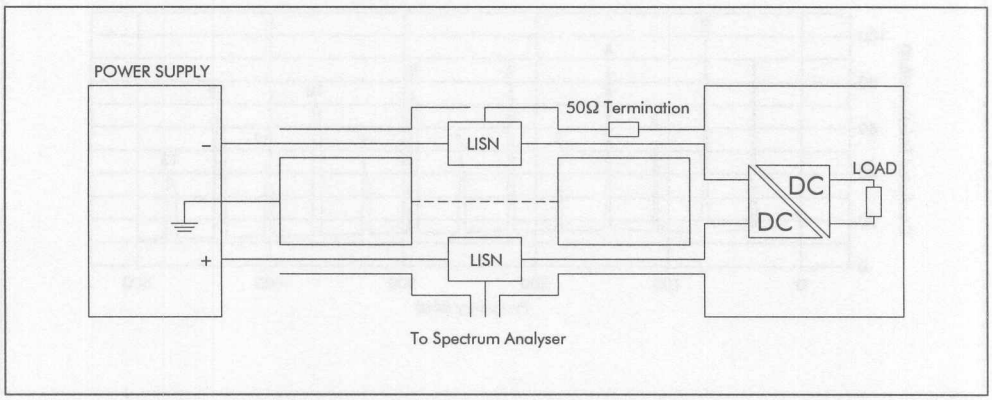


Figure 22 : *Filtered Supply to DC-DC Converter*

hence, will have a frequency spectra. Fixed input DC-DC converters have fixed switching frequency, for example the NMH range of converters has a typical switching frequency of 75kHz. This gives a stable and predictable noise spectrum regardless of load conditions.

If we examine the noise spectrum closely (see figure 23) we can see several distinct peaks, these arise from the fundamental switching frequency and its harmonics (odd labelled line spectra) and the full rectified spectra at twice the fundamental switching frequency (even labelled line spectra). Quasi-resonant converters, such as the Newport range, have square wave switching waveforms, this produces lower ripple and a higher efficiency than soft switching devices, but has the drawback of having a relatively large spectrum of harmonics.

The EC regulations for conducted interference covers the bandwidth 150kHz to 30MHz, considering a converter with a 100kHz nominal switching frequency, this would exhibit 299 individual line spectra. There will also be a variation of absolute switching frequency with production variation, hence a part with a 90kHz nominal frequency would have an additional 33 lines over the entire 30MHz bandwidth. Absolute input voltage also produces slight variation of switching frequency (see figure 24). Hence, to give a general level of conducted noise, we have used a 100kHz resolution bandwidth (RBW) to examine the spectra in the data sheets. This wide RBW gives a maximum level over all the peaks, rather than the individual line spectra, this is easier to read as well as automatically compensating for variances in switching frequency due to production variation or differences in absolute input voltage (see figure 25).

The conducted emissions are measured under full load conditions in all cases, under

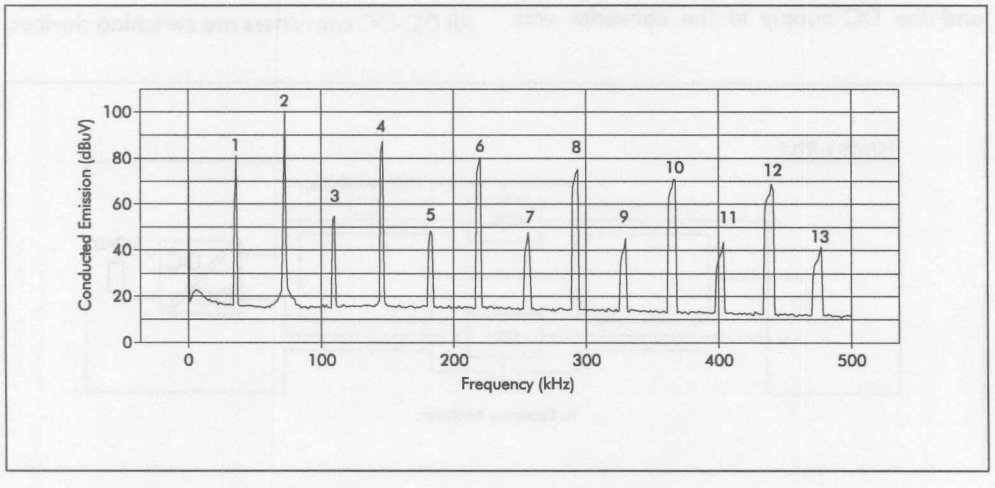


Figure 23 : *Individual Line Spectra*

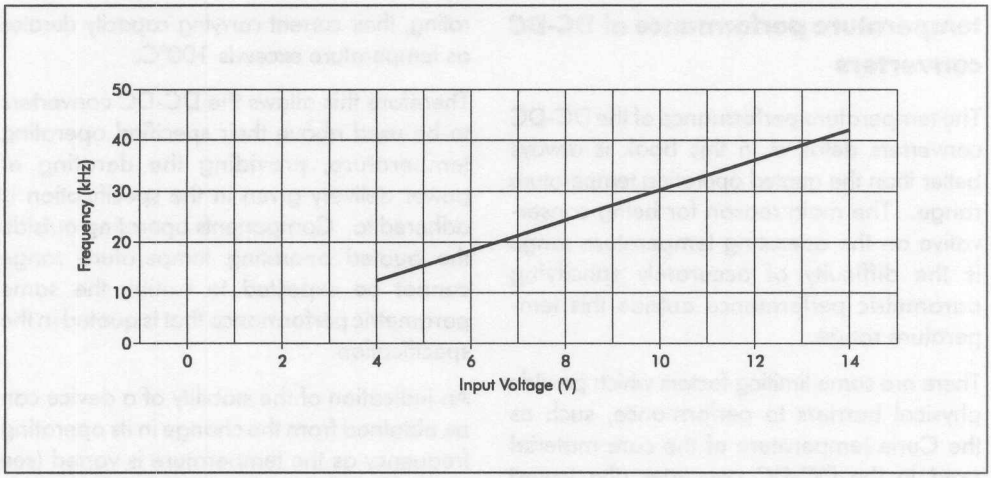


Figure 24 : *Frequency Voltage Dependency*

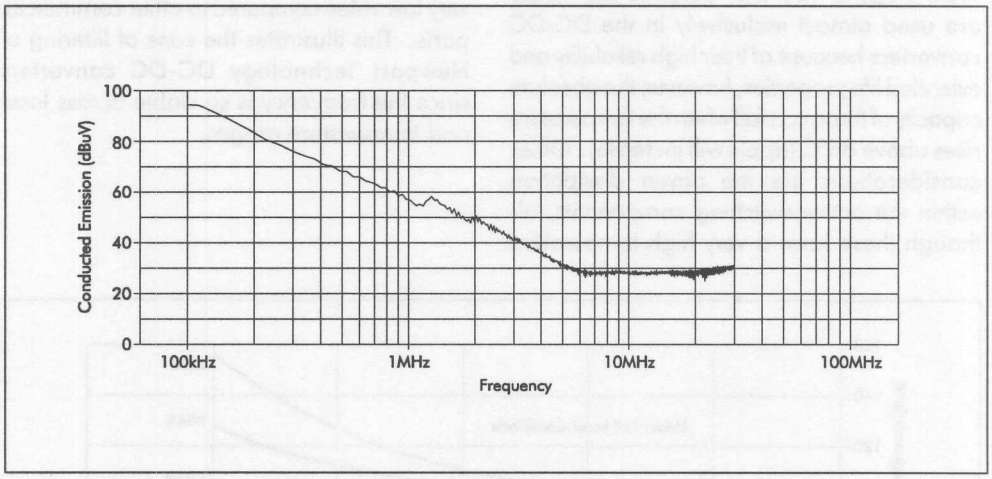


Figure 25 : *NMS Spectrum*

lower loads the emission levels do fall, hence full load is the worst case condition for conducted line noise.

temperature performance of DC-DC converters

The temperature performance of the DC-DC converters detailed in this book is always better than the quoted operating temperature range. The main reason for being conservative on the operating temperature range is the difficulty of accurately specifying parametric performance outside this temperature range.

There are some limiting factors which provide physical barriers to performance, such as the Curie temperature of the core material used in the DC-DC converter (the lowest Curie temperature material in use at Newport Technology is 125°C). Ceramic capacitors are used almost exclusively in the DC-DC converters because of their high reliability and extended life properties, however, the absolute capacity of these can fall when the temperature rises above 85°C (ripple will increase). Other considerations are the power dissipation within the active switching components, although these have a very high temperature rating, their current carrying capacity derates as temperature exceeds 100°C.

Therefore this allows the DC-DC converters to be used above their specified operating temperature, providing the derating of power delivery given in the specification is adhered to. Components operating outside the quoted operating temperature range cannot be expected to exhibit the same parametric performance that is quoted in the specification.

An indication of the stability of a device can be obtained from the change in its operating frequency as the temperature is varied (see figure 26). A typical value for the frequency variation with temperature is 0.5% per °C, a very low value compared to other commercial parts. This illustrates the ease of filtering of Newport Technology DC-DC converters since the frequency is so stable across load and temperature ranges.

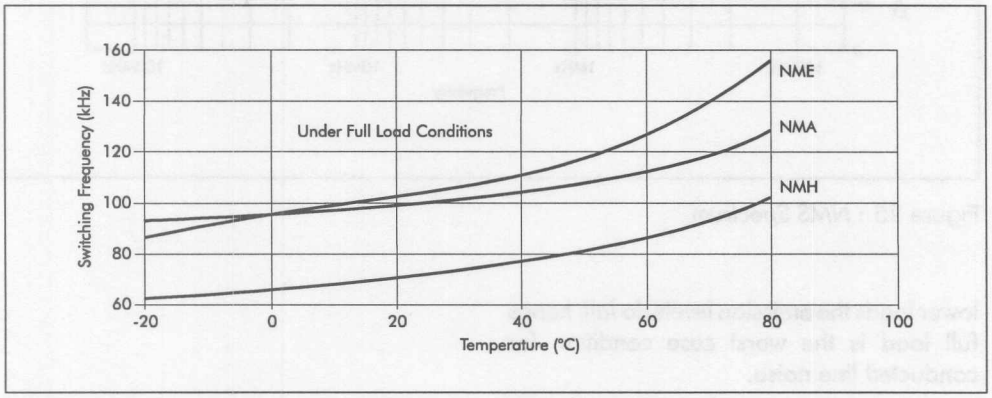


Figure 26 : *Typical Switching Frequency vs. Temperature*

custom DC-DC Converters

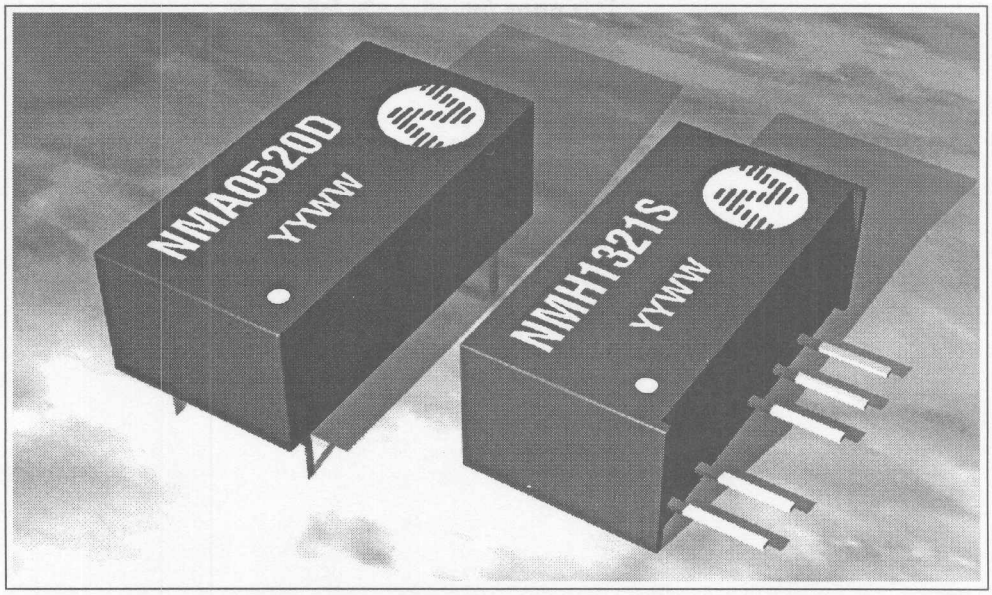
In addition to the standard ranges shown in this data book, Newport Technology have the capability to produce custom DC-DC converters designed to your specific requirements. In general, the parts can be rapidly designed using computer based CAD tools to meet any input or output voltage requirements within the ranges of Newport Technologys standard products (i.e. up to 48V at either input or output). Prototype samples can also be produced in short timescales.

Custom parts can be designed to your specification, or where the part fits within a standard series, the generic series specification can be used. All custom parts receive the same stringent testing, inspection and quality procedures as standard products.

Newport Technology custom parts are used in many applications which are very specific to the individual customer, however, some typical examples are;

ECL Logic driver
Multiple cell battery configurations
Telecommunications line equipment
Marine apparatus
Automotive electronics
LCD display power circuitry
Board level instrumentation systems

To discuss your custom DC-DC converter requirements, please contact Newport Technology technical support desk or your local distributor.



newport technology

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SECTION 1
GENERAL INFORMATION

SECTION 2
DC-DC CONVERTERS

SECTION 3
SALES INFORMATION

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Orders may be placed directly with Newport Technology, Inc. Orders may consist of scheduled deliveries over a twelve month period, but not beyond. When placing orders the complete part number (including package style suffix) as well as the product description should be used. Orders may be placed directly with the company by phone, fax or letter.

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Newport Technology, Inc. has appointed a number of franchised stocking distributors throughout the USA. A current list of franchised distributors can be found later in this section of the databook.

sales representatives

Newport Technology, Inc. has appointed an extensive network of sales representatives throughout the USA and Canada. Only these sales representatives are authorized to promote the Newport product range and any information or data received from other sources is not considered binding.

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All prices quoted are F.O.B. Newport Technology, Inc. Raleigh, NC, USA in US dollars. Federal, state and local taxes are extra and will be applied if applicable. Prices are subject to change without notice.

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Price quotations made by Newport Technology, Inc. or any of its appointed sales representatives are valid for thirty (30) days unless otherwise stated. Delivery quotations are also valid for thirty days (subject to quoted stock not being sold prior to receipt of an order).

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Net 30 days.

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Newport Technology, Inc. acknowledges all orders. Order Acknowledgements include part number (and customer's part number if appropriate), quantity, anticipated ship date from Newport Technology, Inc., item cost, and extended cost. Also shown is the delivery address, invoice address, shipping instructions, customer's purchase order number, Newport internal sales order reference and the date of the order. Unless otherwise instructed Newport Technology, Inc. will normally ship all product by UPS Ground Trac and charge the customer at cost. Product will be shipped in rugged commercial containers suitable for safe delivery to the customer.

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All orders placed with Newport Technology, Inc. are binding. A cancellation charge will be levied if an order is cancelled either before or after the scheduled shipment date.

limited warranty

a) Newport Technology, Inc. (Seller) warrants that the goods sold to Buyer are free from defect in material and manufacture and conform to Seller's applicable published ratings and characteristics in effect at the time and place of shipment. Unless Seller receives Buyer's notice of breach of this warranty within three (3) months of the date of shipment of the goods claimed to be defective, Seller shall have no liability as to such goods under this warranty. Seller shall not be liable for indirect or consequential damages to Buyer, howsoever arising, whether or not based on negligence. Where due to operation of law, consequential, special or incidental damages cannot be disclaimed, they are expressly limited in amount to the purchase price of the Goods. Seller's sole and exclusive liability, and Buyer's exclusive remedy, for breach of this warranty is replacement of Goods proved to be defective. Seller, at its sole option, will repair or replace any Goods found to be defective, except as otherwise provided in paragraph (b) below.

(b) In all cases, Seller's liability under this warranty is subject to the following additional conditions:
(i) Goods that Buyer considers to be defective shall be returned within three (3) months of date of shipment to Seller's designated facility for examination and testing, transportation costs and insurance to be prepaid by Buyer. Upon receipt of such defective goods from Buyer, postage prepaid, Seller will replace the goods unless Seller determines that it is not liable under this warranty as described in paragraph (ii), below; (ii) Seller shall not be liable under this warranty if its testing and examination disclose that the Goods have been modified or altered in any material manner after shipment by Seller or that the alleged defect in the Goods does not exist or was caused by Buyer's or any third person's misuse, neglect, improper installation or testing, unauthorized attempts to repair, or any other cause beyond the range of intended use, or by accident, fire or other hazard;

(c) Buyer and Seller agree that the price is a consideration in limiting Seller's liability under the Contract and Buyer agrees that the remedies provided herein adequately protect Buyer's interests regardless of circumstances that may arise later.

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